THE AMATEUR HOUSE CARPENTER.

THE AMATEUR HOUSE CARPENTER

A GUIDE IN BUILDING, MAKING, AND REPAIRING.

BY

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AUTHOR OF "BUILDING CONSTRUCTION," "DRAWING FOR CARPENTERS AND JOINERS," "THE BOY JOINER," ETC. ETC. ETC.

WITH NUMEROUS ILLUSTRATIONS,

DRAWN ON WOOD BY THE AUTHOR.

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INTRODUCTION.

THERE is always a certain amount of difficulty in addressing amateurs on a subject essentially practical. This arises from the fact that the Author has to appeal, not only to the higher mental faculties of his readers, and to their love of the subject, but it becomes necessary to describe absolute manipulation: he has, in fact, to ask them to unite the knowledge and refinement of men of education, with the practical work of artizans.

Experience, has however shown, that it is easier to engraft practical skill on those who are already in some degree acquainted with scientific principles, than it is to teach correct methods of construction to men who have from their youth been accustomed to work by "rule of thumb," and to pursue their occupations after a certain fashion, just because that fashion has obtained in the different shops at which they have worked.

The Author knows full well how our English gentlemen can work. He is quite aware that in the Crimean and other campaigns, the officers, supposedly "fine gentlemen," showed what gentlemen can do when need calls on them, animated by motives far beyond those which are merely pecuniary, difficulties serving only as incentives to greater exertion; and most of the readers of these lines will be able to call to mind

numbers of the churches of this country, possessing lecterns, pulpits, fonts, &c., made and carved by ladies and gentlemen of the different districts, in a manner which defies the criticism of either the artist or the workman.

These pages then, are written for gentlemen who feel pleasure in active occupation, bringing into play their natural powers of construction, and who, having the necessary leisure, desire to make or repair numerous appliances in the house or grounds — not so much to save money as trouble and annoyance; and they may rest assured that the pleasure they will give to those whose comfort and convenience they thus promote, will richly repay them for the time and trouble they have bestowed on the construction of any of the articles of furniture or ornament described herein.

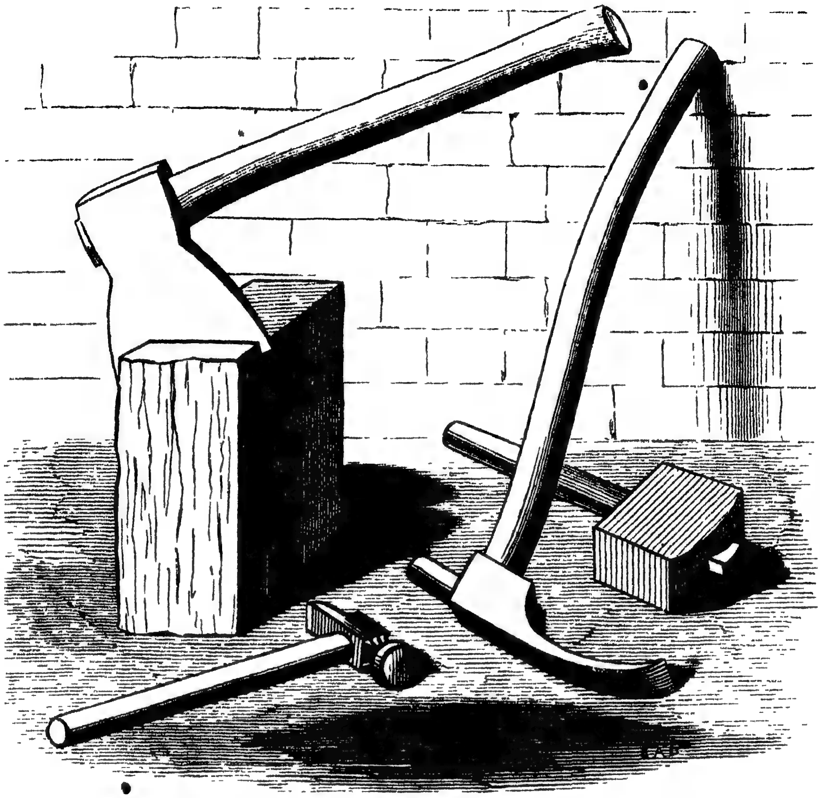
Were it not that every schoolmaster assures his pupils that "there is no royal road to learning" (at the same time that he is cramming his victims after a fashion that royal pupils—at least, those who had the inexpressible blessing of the guidance of the late lamented Prince Consort—would scorn), the Author would say, that to learn to do anything improperly, is to waste time and trouble; and therefore, the tools to be used, and the method of working with them, and such manipulative processes as the workman, be he gentle or simple, should know, are fully and carefully described. The knowledge thus gained will enable the amateur —even if not able to execute the work—to direct the men he may employ; who, from the utter neglect of technical education in this country, will often be found utterly incom

petent to do anything out of the common way, or to suggest a single thing beyond what they have seen other workmen do.

The instructions given will not, it is hoped, be found too technical, although perfectly practical; and the amateur will, perhaps, receive confidence from the information that the Author has himself made all the articles described, so that the hints given are records of what has been done rather than chimerical designs, which look well on paper only.

E. A. D.

London, 1875



A DESCRIPTION OF THE TOOLS USED IN CARPENTRY.

For convenience of reference, the tools are here described in groups as follows: STRIKING TOOLS, SAWS, CUTTING TOOLS, PLANES, BORING TOOLS, PINCERS, GUIDES, and AUXILIARY APPLIANCES.

STRIKING TOOLS.

(Fig. 1.)

THE typical tools of this group are, of course, the HAMMERS, and these are of numerous kinds, adapted to every branch of the various trades in which they are employed. In carrying out the suggestions herein made, the amateur carpenter will require three, viz.,

a good-sized one for heavy work, a medium one for general purposes, and a small one called a "Claw Hammer"—a sort of domestic friend, which may be kept hanging up in some convenient spot *pro bono publico*—a general order being issued that it is to be returned to its place after it has been used. By its aid nails that have fallen out of their places may be restored, or others drawn out, and numerous little matters may be set right, thus preventing damage and annoyance.

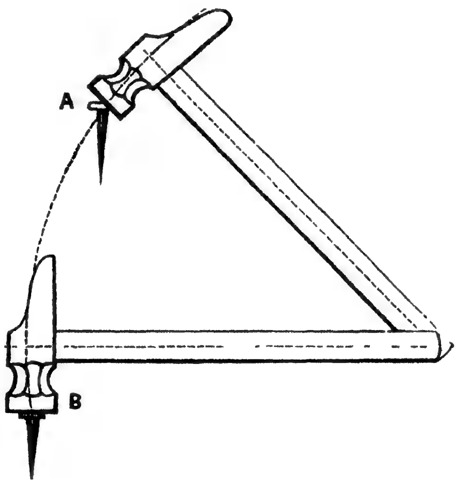


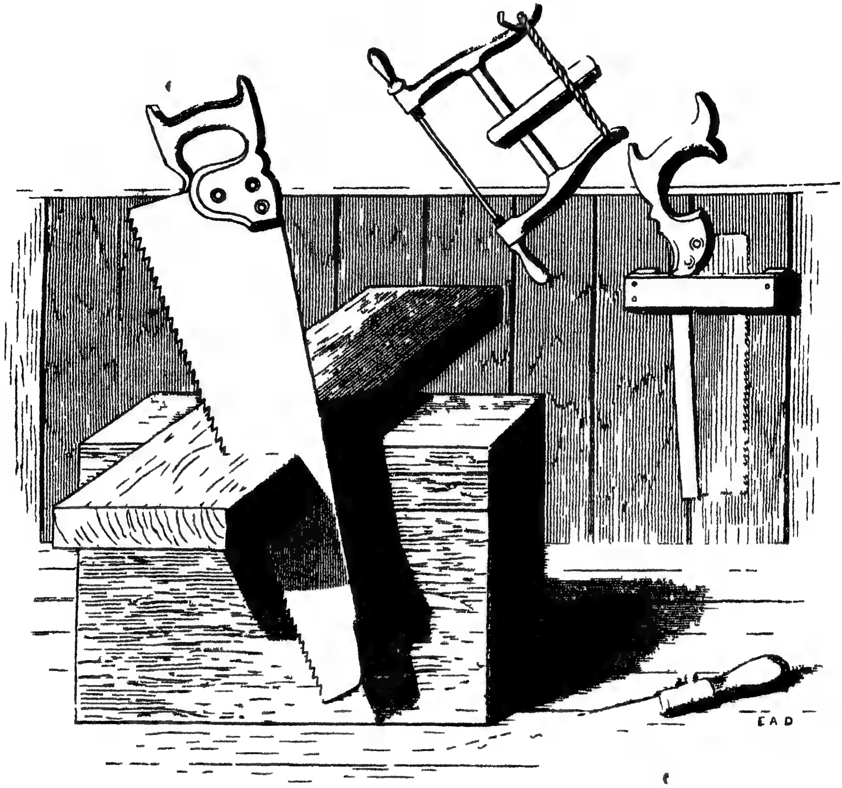
Fig. 2.

The hammer should be held by the end of the handle, and the blows struck should be firm and regular. It will be readily understood that the longer the handle is held, the heavier will be the stroke; and one blow struck when the handle is held at its extremity will be more efficient than a dozen rapid little taps given with the hammer held near its head. It will also be clear that in its progress the head of the hammer travels through an arc of a circle, of which the wrist is the centre, and therefore the arm and hand must be raised above the level of the nail to be struck. This is illustrated in Fig. 2, from which it will be seen that if the nail at A were struck by the hammer, it would be

bent outwards; whilst that at B would be driven perpendicularly downwards.

The MALLET is simply a wooden hammer, the head of which is a mere block through which the handle passes. Its use is to give the necessary blows to the ends of pieces of wood which are being mortised together, or to strike the mortising chisel, or any other tool having a wooden handle which would be damaged by an iron hammer.

The AXE and ADZE, although they are both cutting tools, are also used as heavy hammers, the blows being struck with the back of the head of the tool. The axe is used for chipping or splitting off pieces from a plank or other piece of timber, so as to reduce it approximately to the form required, after which it can be further shaped with the Drawing-Knife—or, as it is termed by some, the "Shaping-Knife"—and finished with the Spokeshave or with the Plane—all of which will be described in their places. The Adze is similarly used on horizontal surfaces: the head is placed at right angles to the handle, and shaped into a hammer at the back. It is scarcely necessary, however, to point out that as, in using either the axe or the adze as a hammer, the sharp edge is directed towards the workman the greatest care is necessary.



SAWS

(Fig 3)

Saws are of various kinds, but it will only here be necessary to describe such as are likely to be used by the amateur It is, of course, very easy to form a large collection of tools, but it is not wise to do this. it is, by far, better to purchase only such as are absolutely required, adding to the stock from time to time By this plan the habit is formed of getting as much work as possible out of each tool; and further, it is not likely that the amateur carpenter will undertake the larger and rougher departments of the trade, such as planing large boards or sawing them down lengthwise, knowing that they may

be obtained thus prepared for very little more than they would cost in the rough, as at most timber-yards there are machines for sawing and planing, and thus it is advisable to order the wood in lengths, planed and edged.

The RIPPING-SAW will therefore not be needed. It is large, has coarse teeth, and is used in sawing the wood lengthwise, which it does very rapidly.

The HAND-SAW will, however, in the amateur's workshop, take its place, and will be found to answer every purpose. It must be pointed out that the saw only cuts in the downward motion, and that therefore it is only then that force should be used, the tool being merely drawn up after each stroke. Sawing should not consist of a series of short jerks, but the whole length of the saw should be employed. To saw in exactly a straight line is a result of some practice; and to obtain this, the amateur carpenter should rule a line across a piece of wood and saw closely to it, not really cutting it away, but leaving it just visible, in order that he may be sure that the saw has really gone in a straight direction; and the line should be marked on the back as well, in order to obtain the power of sawing in an exactly vertical plane, so that the end of the wood may be square with its surface.

The board to be sawn should be placed across two kitchen chairs, or trestles, the piece to be sawn off projecting towards the right hand —this piece should not be supported in any way during sawing, but when it is nearly severed it should be lightly held by the left hand to prevent its breaking off. The workman stands on his right foot, the left knee pressing on the board, which is also kept down by the left hand. Smaller pieces may be secured in the bench-vice. The saw should be started very gently at the extreme angle of the wood, force not being used until the edge is passed, so that the angles may not be split off.

The TENON-SAW is a smaller tool, oblong in shape, and being very

thin, is supported along the ridge of the back by a brass or iron rim, which gives stiffness to the blade. This saw is sold in various sizes; and it is advisable to purchase one of the smaller and one of the larger sizes, and with these very accurate work may be done.

All saws should be kept in good order, and for this purpose should be sent occasionally to the tool-shop to be sharpened, after which they will be found to work rather roughly for a short time. This may, however, be remedied by sawing through some pieces of hard wood, by which means the burr left by the file is removed.

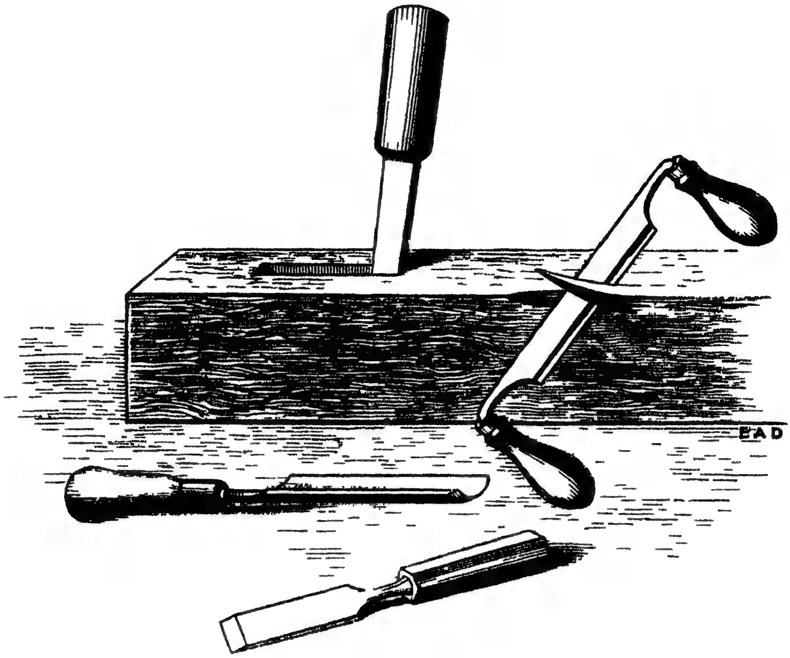
It is needless to say that the saws should be kept bright and free from rust; and if they are hung up against the wall of a workshop where there is the slightest tendency to damp, they should be greased by rubbing a little tallow or fat over them. They may also be protected against damage by a sheath made of a piece of wood of the length of the saw, in which a groove about 2 inches deep has been cut by the very saw for which it is intended. This plan, however, could only be pursued with the tenon-saw; but for the hand-saw a different one must be adopted, as, of course, it would be most difficult to saw a deep groove quite straight in a piece of wood of the required length. In this case, therefore, two pieces of board, about 3 inches wide and ½ inch thick, should be prepared, and these should be united at their lower edge by a strip of wood a little more than an inch wide, a space being left just wide enough to admit of the saw fitting tightly between the two sides.

The TURNING-SAW is one which will be indispensable to those for whom this book is written, inasmuch as by its means the curved parts of ornamental work are cut. This saw—made on a large scale—is in common use on the Continent, where it supplies in many cases the place of the hand and tenon saws. The blade (which may be obtained of various widths) is held in a frame consisting of two side pieces kept apart by a cross-bar, fitted to them by a tenon at each end, but not

in any way fastened. The handles end in pieces of round iron, in each of which a slot is cut; in this the saw is placed, and secured by a wire pin or small nail at the one end, whilst a movable pin is placed at the other. A cord is then wound around the two upper ends of the side pieces of the frame, and in this a straight piece is inserted, which being twisted round until the whole frame is tightened up, is moved slantingly, so as to pass over the cross-bar, against which it presses, and by which it is prevented returning.

The method of using this tool will be further explained when its services are called into requisition.

The KEYHOLE-SAW is used for purposes similar to those in which the last-named is employed, but it is not by any means as efficient, being, in fact, adapted for small purposes, such as sawing out a key-hole—from which indeed it derives its name. Blades of various sizes are required, and these are secured in the handle by means of screws.



CUTTING TOOLS

(Fig 4)

The separation of the tools into classes is, of course, an arbitrary one, and there is necessarily a certain connection between each of the classes. Thus, both axes and saws may be called cutting tools; but the former act more by the force applied than by their absolute sharpness, and a smooth continuous cut cannot be obtained by their means, whilst refinement is out of the question: the latter may be said to rasp their way across or along the fibres of the wood, and the cut requires smoothing by the plane or other means. It will, therefore, be seen that the term "cutting tool" applies principally to the group of chisels—varying in form and size.

The DRAWING-KNIFE forms a connecting-link between axes and chisels: it is, as it were, an axe worked by being drawn edge downwards along the wood, instead of being struck against it by force; and

thus, though it is not adapted for splitting large pieces of timber or for the rough work which may be accomplished with the axe, a greater approach to refinement may be made, and the work may be prepared either for the lathe or the plane.

Again, the Drawing-Knife is a kind of chisel worked by two handles: by being drawn towards the operator, instead of being pushed from him, it can be used either on its sharp edge, or, as in concave curves, it is worked on its bevelled side, and may thus partake of the smooth movement of the chisel rather than the chipping action of the axe.

In using either the axe or the drawing-knife, the direction of the fibres of the wood must be observed, and the tool guided accordingly, so that it may not work too deeply into the wood. A little practice will soon enable the amateur to manage the tool satisfactorily.

Chisels may, as far as our present purposes are concerned, be divided into Paring Chisels, Mortising Chisels, and Gouges.

PARING CHISELS are straight and flat pieces of steel acutely bevelled at the edge at right angles to their length. They are of various sizes, and the amateur will find four answer all his purposes. These sizes should be ¼ inch, ½ inch, 1 inch, and 1½ inch.

MORTISING CHISELS are thicker in the body than the others, being formed, as it were, out of square (or rather, oblong) bars of steel, and have a widely-spreading shoulder, forming an abutment for the handle, which is proportionately large. The mortising chisel is driven by the mallet: the iron-headed hammer should never be used for this purpose. The sizes of these tools most useful are ¼ inch, ½ inch, and ¾ inch.

The GOUGE is simply a chisel, the blade of which is curved in a direction parallel to the length of the tool. The sizes most useful are ¼ inch, ½ inch, and 1 inch, and the curves of these should not be too deep.

In grinding chisels the bevel should, in the first instance, be very

flat, and this portion is performed on the grindstone; the tool is then to be finished on the oilstone. It must, however, be pointed out, that this bevelled part should not be allowed to become curved: it should consist of two surfaces. It should not be ground like Fig. 5, but like Fig. 6—

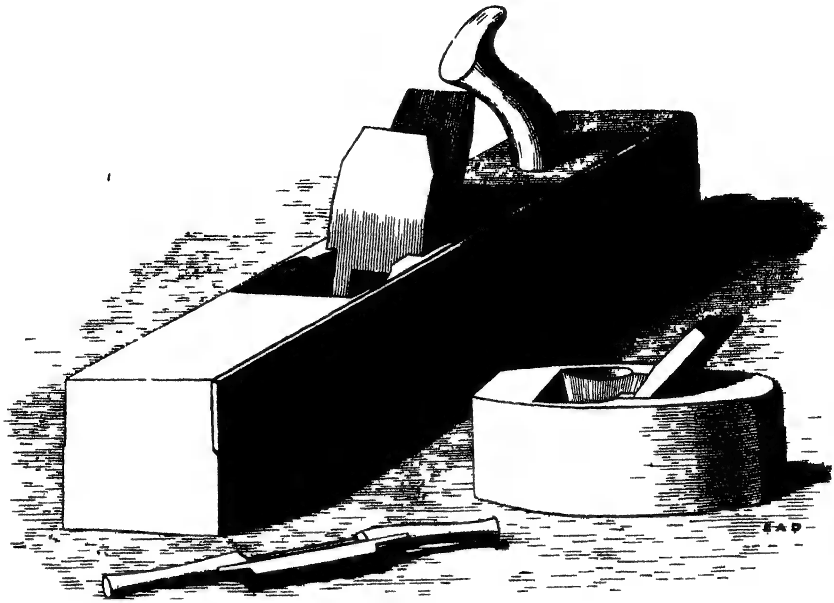
Fig. 5.

Fig. 6.

the surface *a* being that made by the grindstone, and that at *b* being the extreme edge as left by the oilstone. If the amateur has not provided himself with a grindstone, he can send his tools to a tool-shop or working cutler to be ground; and as far as the grinding is concerned, this plan will generally be found most convenient, as much practice is required before the power of grinding well is acquired: even if in the country, the village carpenter will be able to render good service, either in grinding the tools or in showing the method to be pursued. It is absolutely necessary, however, that the power of setting tools ready for use on the oilstone should be acquired, as this is so constantly required, that the work will be hindered if the tools are sent away; besides which, the people at tool-shops seldom set the tools with the refinement required by the workman.

Gouges are ground, as far as their outer side is concerned, on the grindstone, but require to be turned about during the operation; after this they are to be finished on the oilstone. But they require that the inner side should also be slightly ground; and this is done by means of pieces of stone called "slips," which are rounded at their edges. This requires great care and some practice to accomplish successfully.

The SCREWDRIVER, although not a cutting tool, is, in form, nearly allied to chisels, and is too well known to need description.



PLANES.

(Fig. 7)

Planes may be considered as chisels, fixed in solid guide-blocks, in order to prevent their sinking more deeply into the wood at one part than another; and it will thus be seen that the longer the plane, the more is this object accomplished. Hence, for edging long boards which are to be glued together, and which, therefore, require that they should be absolutely true, a plane called the "jointer," which is about 30 inches long, is used. Next in size to this is the "trying plane," which is about 24 inches long, and is used for similar purposes.

The planes which are, however, best adapted for the amateur are—(1) the Jack-Plane—from 14 to 17 inches long—and which, as far as the articles suggested in this book are concerned, will answer every purpose; and (2) the Smoothing-Plane, which is about 8 or 9 inches long, and is narrower at each end than in the middle. These planes have two irons in them: the one is the cutter, and the other is the break-iron—the purpose of which is to bend up the shaving cut by the sharp edge of the other iron.

When using the jack-plane for working down a rough surface, the break-iron should be brought down to about ⅛ of an inch of the cutting edge, but for finer work it should be placed at about $\frac{1}{20}$th from it; and in the smoothing-plane it should be brought nearer still. The irons are then to be screwed together, and placed in the recess made in the body of the plane to receive them, and are there secured by the wooden wedge: the edge should project as little as possible beyond the sole or bottom of the plane; and, to see that it is rightly placed, and that one angle of the blade is not farther out than the other, the plane should be turned upside down, and placed on a level with the eye, when, by looking along the surface, the slightest error will be detected. If it be necessary to bring the iron farther out, this should not be effected by striking it on its upper end, but by a few taps on the front end of the body of the plane itself, by which means it may be most accurately adjusted; and if it be found to project too much, it can be withdrawn by striking on the back end of the plane. After the latter operation, it will be necessary to give a blow or two with the hammer on the wooden wedge, which will have become loosened.

There are two other kinds of planes which will be of service to the amateur, but which will require great practice before they can be used with success: these are the Rebate-Plane and the Match-Plane.

The REBATE-PLANE is used in forming a rebate (or, as it is generally called, a "rabbet") along the edge of a board. It is a narrow plane, and may be had of two kinds: in the one the iron crosses the sole at right angles to the length of the plane; and in the other it is set obliquely. The first is used in cutting a rebate parallel to the fibre of the board; and the other in performing a similar operation at the end —that is, crosswise to the fibre.

The difficulty experienced by the amateur is in making the plane travel in a true parallel to the edge of the board; and there are planes made with guides to accomplish this; but these are very much more

expensive, and the following means will answer the purpose quite as well: Let A be a board, in the edge of which it is required to cut a rebate ½ inch wide and ¼ inch deep; a strip of these dimensions has literally to be planed away, and the plane must therefore be prevented travelling horizontally farther on the surface of the board than ½ inch, and vertically it must not be allowed to sink deeper than ¼ inch. These planes are made from ¾ inch to 2 inches wide.

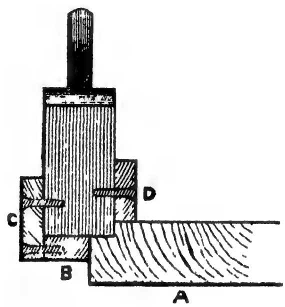


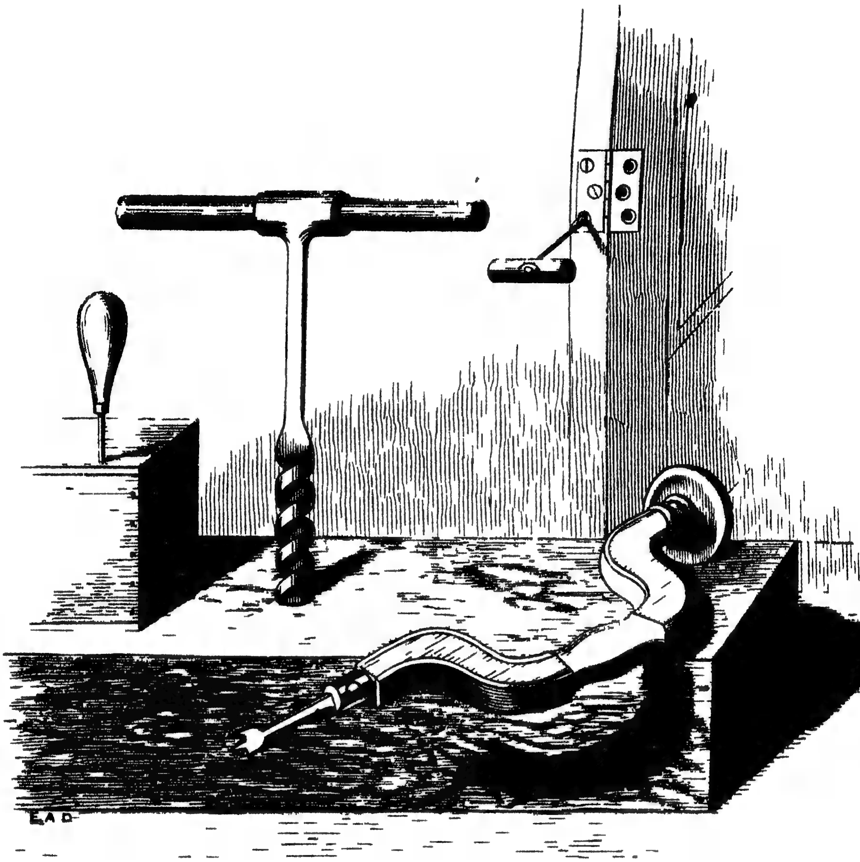
Fig. 8.

We will assume that the one with which the work is to be done is 1½ inch wide. Plane up a strip of wood (B, Fig. 8) to the width of 1 inch (the thickness will not be any consideration), and screw it at right angles to another piece (C), thus forming a letter L. This will form a case, which will, when placed and fastened to the side of the plane by a couple of screws, shut off 1 inch of the width of the sole, allowing it to encroach upon the surface of the board to the extent of ½ inch only; a mere strip (D) screwed on the other side at ¼ inch from the sole, will prevent the plane sinking deeper than is required. On no account should the guide be screwed to the sole of the plane, which should always be kept perfectly smooth—the surface uninjured by screw-holes. Nor is it necessary to damage the sides of the plane by more than two small screw-holes; for the same side piece, C, may be permanently used, the width of the strip B being altered according to circumstances, and the

width of D can also be regulated either by planing a portion off below the screws if the rebate is to be deeper, or moving the screws lower down in the strip if it is to be shallower, taking care that the holes correspond with those in the side of the plane, and that the strips do not cover the apertures through which the shavings should escape.

MATCH-PLANES are sold in pairs, the one of which cuts a groove in the edge of a board, and the other cuts the corresponding tongue in the piece to be united to the former one, forming a rebate on each side. This method of joining boards is sometimes accomplished by grooving both boards, and inserting a strip, forming an artificial tongue.

Nearly allied to planes is the SPOKESHAVE. This is a piece of wood about 10 inches long, into which a thin blade is inserted parallel with the length. It is used to finish or smoothen concave and other curves, into which planes could not work, the forms having been previously given with the drawing-knife.



BORING TOOLS

(Fig 9)

The most commonly used boring tools are the Brad-awls and Gimlets.

BRAD-AWLS are of various sizes—from $\frac{1}{16}$ of an inch to $\frac{1}{8}$ or more: the smaller ones being generally termed "sprig bits." These tools are only adapted for working in pine or the other soft woods, as, of course, they are driven in by sheer force; but they are exceedingly useful for small purposes, as holes may be bored for the insertion of sprigs much smaller than could be done with even the finest gimlet. In commencing to bore a hole with a brad-awl, the straight edge of the point

across the fibre of the wood, and not parallel to it. By holding it upright in this direction, and applying pressure until the point is some little depth in the wood, then twisting it backward and forward, the material will be pierced, and the risk of splitting will in a great degree be diminished. The larger sized brad-awl may be used as a small screw-driver.

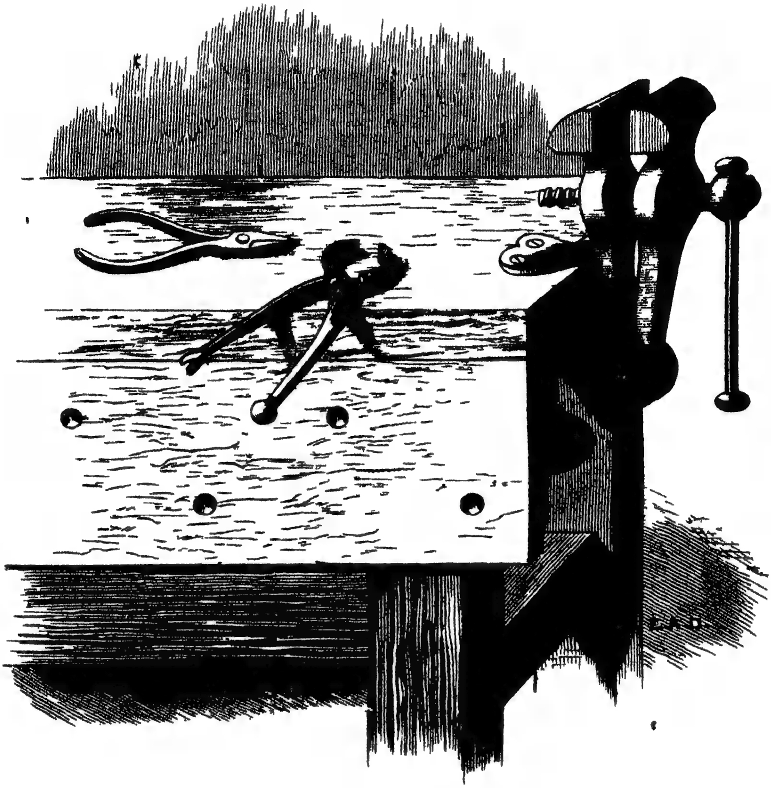
GIMLETS are of two kinds: plain and twisted. The former are something like very small gouges with a screw at the point; the latter are cut with a spiral groove up to about half their length. These are far preferable to the other, as, in the first place, they can, after they have once taken hold of the wood, be driven in by being merely turned, requiring but little force; and secondly, they make a cleaner hole, as the wood removed is at once forced upward along the spiral groove. The amateur should provide himself with three different sizes of gimlets.

Nearly allied to the last are AUGERS, which are simply gimlets on a very large scale. These also are of two kinds: the Shell, which is like a large gouge, has a flat sharp edge turning up at the bottom; the other is called the "Screw Auger," which, like the screw gimlet, has a spiral groove running up its length. These may be had singly or in sets to fit the same handle: their use is to bore large holes to a very great depth or quite through thick wood. There are also "Brick Augers" for boring through brick walls.

For making large holes—in fact, for cutting circular apertures—nothing can exceed the usefulness of the "BRACE AND BIT." The brace consists of a curved frame or handle, at the one end of which is a broad flat head on which the frame rotates, and at the other end is a socket provided either with a spring or thumbscrew, and in this the bit is placed. The bits may be bought singly or in sets from ⅛ inch to 2 inches. A set consists of from twenty-four to thirty-six bits. The bit is a piece of steel about 4 inches long, which expands into a

semicircular form at its end; in the middle of this broad end is a spike or sharp point, which, on being pressed into the wood, acts as a centre, on which the bit rotates. On the one side of this the bit is shaped like a chisel, which, as the brace is turned round, cuts a deep circle; the other side of the bit is bent horizontally and brought to a very sharp edge, which acts as a horizontal chisel; and this, following the vertical chisel, scoops up the wood, the edge of which has been set free. If a hole is to be cut quite through a piece of wood, another piece should be held tightly pressed against the distant side, so that the circle may be cut quite through without being broken at its edge; or, as the central spike is the longest, its point will first make its way through, it may be withdrawn and the point inserted in the small hole visible, the cut being then returned to meet the previous one. This, however, requires great care, and only the slightest possible pressure must be used.

Amongst the bits one should be purchased having a conical end, on which grooves are cut. The use of this is to cut a conical cavity around a hole bored by the gimlet, so that the head of a screw to be inserted in it may be countersunk, so as to be level or flush with the surface of the wood.



HOLDING TOOLS

(Fig. 10)

Under this head it will be convenient to include several tools of the same character

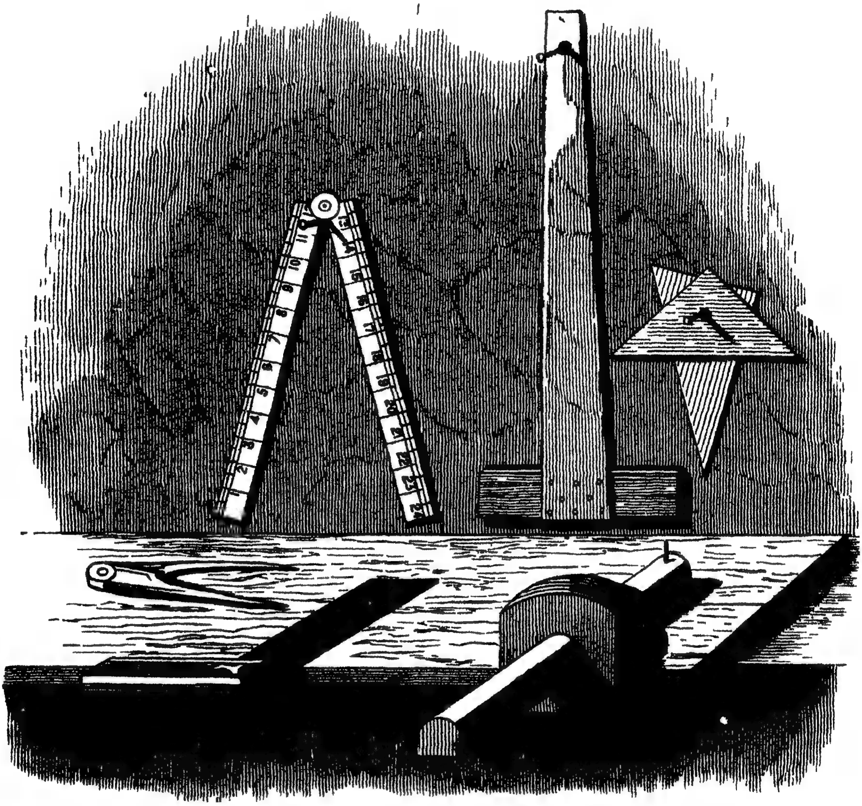
1 The COMMON PINCERS, used for drawing out nails, having a claw at the end of one leg, the purpose of which is to raise bent nails, so that they may be clutched by the jaws of the tool

2 NIPPERS, which are simply small pincers made of steel, and having sharp edges to the jaws, they serve as scissors for cutting wire.

3 PLIERS, which have straight cheeks, and are used for drawing out

small nails or for bending wire. They are made of various sizes; and for very neat work, those used by watchmakers should be purchased. There is also a kind of pliers called "side-cutting," which have sharp blades on one of their sides for cutting off the end of wire when it has been bent: these are very convenient, as the time and trouble of putting down a pair of pliers and taking up the nippers is saved; and there is also a kind of pliers sold called "round-nosed," the cheeks of which are rounded, so that wire may be easily bent into curved forms, such as loops, rings, &c. All of these may be had black or bright: the black are just as good as the bright in every respect but appearance, and are about 25 per cent. cheaper.

The VICE must be considered as a fixed pair of pincers. The one which will be found most useful to the amateur is the Lancashire Board Vice. This can be screwed to a work-bench or table, where it will be very serviceable in holding any piece of metal to be filed or cut; it is also provided with a small block of steel to serve as an anvil. The Hand-Vice is one in which a piece of metal may be tightly screwed so as to be held more firmly than by means of either pincers or pliers, and has an advantage over these—that is, may be laid down without the article held being released.



GUIDING IMPLEMENTS

(Fig. 11.)

These tools—or perhaps some of them should be termed "implements"—are such as are used in marking out the lines to be cut, the sizes of the different parts, and the direction of the various lines.

The one most deserving the name of "tool" is the GAUGE, since it is used not only for marking widths, but may also be employed as a cutting tool when the board is very thin. In its simplest form the gauge consists of a block about 3 inches square and 1 inch thick, through which a stem or rod about 1 inch thick passes, and this can

be moved one way or the other, and can be secured at a given part by a thumbscrew or wedge. Near the end of the rod is placed a steel point, and this can, by moving the rod, be brought nearer, or taken farther from the face of the block, the distance between the point and the block regulating the width from the edge of the board to the line to be marked. Some gauges have two of these points for the purpose of marking at once the width of either a tenon or mortise, or both, and they are hence called "Mortising Gauges;" and some are provided with flat and sharp points for cutting, and these are called "Cutting Gauges." The marking gauge may be sharpened so as to be used as a cutting gauge, and the cutting gauge may be used as a marking gauge. The amateur will not require both. The method of using these will be explained in actual practice.

The COMPASS is too well known to need description. The amateur is recommended to make better use of it than the regular workmen generally do. The common habit, when a distance is to be set off, is to take the 2-foot rule and mark the size by means of a carpenter's pencil. This may produce results near enough for the large work of the constructive carpenter; but it is not neat or accurate enough for the house carpenter or joiner, who should be as the Germans call him, "*ein fine zimmermann*"—a "fine" or "neat room-man,"—to whom the smallest inaccuracy is of importance. Thus the 2-foot rule may do very well for numbers of feet; but where inches and minute portions of them are concerned, the measurement should be taken from the rule in the compass (which should be held upright), and should then by its means be transferred to the wood.

The TWO-FOOT RULE will require but little description, being known to all. Of course, it will be understood that there is no reason why the rule should be 2 feet long excepting convenience of size.

The SQUARE consists of a piece of mahogany or rosewood, into which a steel blade is fixed at right angles; and the BEVEL is a some-

what similar implement, in which the blade is movable, so that it can be set to any angle.

FILES and RASPS are of great use in rounding off edges and corners, and for several other similar purposes. Those used for wood have their teeth wider than those for working in metal, so that they may not become clogged by the dust which they take off from the wood; and they should never be used for filing metals. The amateur carpenter should provide himself with one flat file, one half-round, and one round, one flat and one half-round rasp, and the same number of files for metals: these may be of a smaller size, and a triangular one should be added. The rasps will not be required for this purpose.

The T-SQUARE and SET-SQUARES (shown in Fig. 11), will be referred to in connection with Plan Drawing, page 236.

AUXILIARY APPLIANCES.

The CARPENTER'S BENCH is a very strong table, to which is fixed a large vice for holding boards whilst their edges are being planed, &c., and on which is a "stop," against which they abut when planing their surfaces.

Next must be mentioned the GRINDSTONE, which has already been alluded to. Various kinds may be seen at the tool-shops, and the stone may be had mounted in various ways. Thus, in Fenn's improved arrangement, the stone is mounted in a cast-iron frame, with treadle or handle, and improved water-float, which avoids the stone running in the water; then there is the improved BENCH STONE, which is smaller than the last, so that it can be placed on the bench, with telescope treadle and iron frame; or a very nice stone may be procured, which

is supplied with multiplying wheels, by which the speed may be much accelerated; or a very good stone, mounted in a simple deal frame, may be obtained for a very small sum.

In grinding tools, care should be taken to employ the whole width, so that the grinding surface may be kept level, as, of course, any grooves in it will preclude the chance of grinding a plane-iron or chisel to a good straight edge; and this surface should be kept in order by grinding on it occasionally a straight piece of iron, or holding a piece of hard stone against it whilst it is being turned: in the latter case a little sand and water will increase the efficiency of the operation. If a tool has been roughly broken off, it should, until reduced to something like a straight edge, be ground on one of the sides of the stone, and afterwards finished on the proper grinding surface.

The stone should not be allowed to remain soaking in water; and, as it will not be in continuous use, the stone may be removed or the water poured off, or an arrangement may be made by which the trough containing the water may be lowered.

As already stated, unless the amateur engages largely in carpentry, it is scarcely worth his while to grind his tools if living in town; but in the country, the ability to do this will be of great service to him.

There are various kinds of OILSTONES. The Turkey was at one time generally adopted; but there are now a number of others—the Arkansas, Missouri, Charnley Forest, Welsh, &c., &c.—each of which has its advantages. On the whole, the amateur will perhaps find the Arkansas best suited to his requirements. The oilstones may be purchased fitted in boxes; or, the stone having been obtained, the amateur carpenter will find but little difficulty in mounting it.

The box consists, in the first place, of a block of wood—say mahogany—about ½ an inch wider all round than the stone, and about doubly as thick: in this a recess is to be cut deep enough for the stone to sink to about half its thickness. The upper portion of the

box is made in a similar manner, or it may be made of a rim to fit exactly round the stone, and to this a top is to be attached. The bottom of the stone must be roughened, and some plaster of Paris mixed with water having been poured into the cavities, and the stone pressed in, it will, when the plaster has set, be fixed firmly in its place. There is no objection to a little oil being allowed to remain on the stone, but it should be clean oil, which, by soaking into the stone, will render it less absorbent than when new, and thus avoid the necessity of constantly applying oil when setting a tool; but after each time the stone has been used, it should be wiped clean—for it will be evident that the black greasy matter which is then spread over the surface, is a paste composed of steel powder, which has been ground off the tool, and oil; and this, of course, fills up the pores of the stone, thus diminishing its efficiency.

As already mentioned in relation to the grindstone, the whole of the surface should be employed; but if, after long use, some parts have become lower than others, the stone should be ground with some finely-sifted sand and water upon a flag-stone.

A separate piece of stone should be used for gouges, and grooves will after a while be worked in this, adapted to the various gouges which are regularly sharpened in them. This, of course, refers to the outer side only of the gouge; the inner side is to be whetted by means of the "slips" already referred to.

In connection with the oilstone, the necessity of a small OIL-CAN suggests itself. This may be obtained at various prices, from 8*d.* to 4*s.*, according to their construction, and the choice must be left to the taste of the purchaser.

A very useful appliance is a BENCH-ANVIL; and perhaps that best adapted for the purposes of the amateur is one used by tinmen, called the "Extinguisher Stake," which presents a broad flat surface at one end, and is brought to a rounded point at the other. This may either

be placed when required in a hole in the bench, or may be fixed in a stand turned out of a block of hard wood.

A SCRIBER is a steel point fixed in a handle: its use is to mark the line in which wood is to be sawn—a purpose which is sometimes accomplished by the carpenter's pencil, or one of the brad-awls. The scriber is, however, more accurate in its work than either of these.

A BRAD-PUNCH is simply a piece of steel brought to a blunt point at one of its ends: the flattened end of the point is placed on the top of a brad, which, on the punch being struck with the hammer, is forced down, so that the surface may be planed; the small remaining hole may afterwards be filled up by the painter.

The GLUE-POT is, of course, one of the most important adjuncts in a carpenter's workshop. It consists of an iron pan, in which another one is placed—the space between them containing water. The glue should be broken up and placed to soak in cold water overnight; after which the glue-pot should be placed on the hob near the fire until the glue is melted. When used, it should be very hot and about the consistency of cream. Both the pieces of wood to be glued should, if possible, be warmed, so that the glue may not be suddenly chilled; and when glue has been applied to each, they should be rubbed together for a second or two, and then tied or clamped, so that they may be brought as nearly as possible into contact—the layer of glue between them being infinitesimal, and not enough to keep the pieces really apart. The extraneous glue should be removed before it becomes quite hard.

Any other tools or appliances which may be required will be spoken of in connection with the work which may render them necessary. The foregoing list, however, will be found to contain a very ample supply of all such as the amateur is likely to want.

The question of separate tools, *versus* a complete tool-chest, is one which will necessarily arise; and the answer must, to a certain extent, be given by the proposer of the question. It is, to a very great extent,

a matter of taste; but the following considerations will have some weight:

1. That unless the tool-box be purchased at a first-rate shop, the tools are not to be depended upon—several secondary articles being put in to make up numbers, and these are absolutely useless.

2. The tools are generally of a smaller size than are useful for work of any extent.

3. The tools, by being all thrown together in the bottom of the box, the chisels, &c., become injured, and unless great care be exercised, the hand is liable to be cut in taking out a single tool, unless all are previously removed, so as to reach the one required. This inconvenience is, however, obviated if the regular carpenter's chest be ordered with a rack all round the inside, in which the edge tools, &c., are placed.

If, however, the amateur has convenience in his house to set apart a room as a workshop, he will certainly not require a tool-chest, but will be able to choose and buy his tools separately; and, by placing them in a rack on the wall in front of his work-bench, he will see at a glance the tool he at the moment may require, and will readily be able to obtain it. Instructions for making such a rack will presently be given.

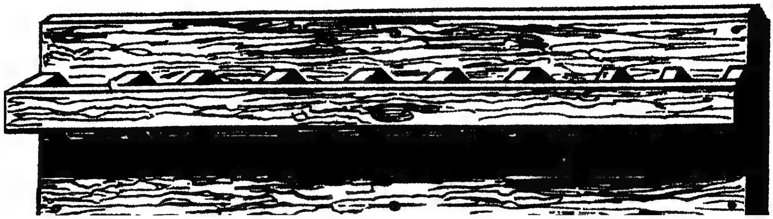
If each set of tools is kept at a particular part of the rack, it will save much time, for the eye will soon become accustomed to the positions, and will at once seek the tool required in its right place, instead of being compelled to travel along the whole rack. The tools may also be graduated, so that the larger chisels, gouges, gimlets, &c., are always found towards one end (be it left or right) of the space allotted to the group.

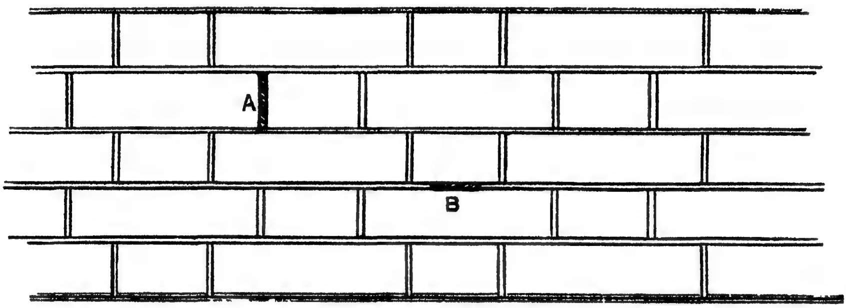
These things may seem trifles, but much comfort and convenience will be found to arise from them; for a gentleman, who, of course, can only devote a limited amount of time to carpentry as an amusement, cannot afford to spend a large portion of that time in hunting for his

tools, whilst the annoyance of having to do so is likely to deter him from following his taste for the work itself.

In the course of these pages instructions will be given for making a cupboard, and the ingenuity of the amateur will soon suggest means of uniting the advantages of the rack and tool-chest, thus enabling him to lock up his tools when away from home—by this means, not only avoiding the risk of children playing with them, but also preventing their being used for purposes wholly foreign to their intention by domestics, who seem to think that packing-cases must be opened with nicely-set chisels, struck on their handle with the iron hammer; and that a claw-hammer or a pair of pincers are not at all adapted for taking out nails, but that very sharp carving tools are specially necessary for that purpose; and who, on being questioned as to some missing tool, favour the amateur with the information that it has only been used for a few minutes (long enough to destroy a dozen chisels) in the kitchen; or that the axe is in the coal-cellar, the proper coal-hammer having been lost "long ago," even in the days of their predecessors.

Whether the rack, the tool-chest, or the tool-cupboard be adopted, a tool-tray, in which just such tools, nails, &c., as may be wanted in any little repairs in the grounds or at any part of the house, may be conveniently carried, will be found useful; and directions for making one will be given further on.





A TOOL-RACK.

(Fig. 12.)

The uses of a rack for tools having been pointed out, we now proceed to describe the method of making and fixing one. The back should be made of an 11-inch board, ¾ inch thick; the length must, of course, depend on circumstances.

As it will, of course, be necessary to give measurements of the various objects and their several parts whilst describing the construction, it is desirable, at starting, to explain that workmen are accustomed to indicate feet by one dash (′) and inches by two (″), and the relation of one side to the other by the sign ×. Thus, instead of stating that a piece of board is three feet six inches long, and two feet four inches broad, these dimensions would be put down—3′ 6″ × 2′ 4″.

At about one-third of the width from the top a line is to be ruled,

or, rather, marked with the gauge. This is done in the following manner: Having loosened the stem of the gauge, which is kept in its place either by a screw or a wedge, fix it so that the distance between the steel point and the block is precisely the length required—viz., 2 inches; then, grasping the other end of the stem with the right hand, the thumb resting on the block, draw the gauge along the board, keeping the block close to the edge by which it is guided—the left hand either holding the board, or, if that should be unnecesary, slightly pressing on the end of the gauge. The steel point should project very slightly, as it is only required to mark but not to cut the board. A number of small blocks of wood are now to be prepared, and these are subsequently to be nailed at intervals along the board close to the line previously marked, leaving spaces between them adapted to the widths of the various tools; and as it is most likely that a 2-inch chisel will be the widest tool used by the amateur, this will be the greatest distance required. Before these are attached to the back, a strip of ½″ wood, 2″ wide, is to be prepared—its outer edges being slanted off (called "chamfered" or "splayed") by means of the smoothing-plane; and having placed one of the blocks at each end of the larger board and one in the middle, holes are to be bored through the long strip and through the blocks, and both are to be nailed together through the back-board. The nails used should be thin flat-headed ones, 2½″ long. The back-board being ¾″, the blocks ¾″, and the strip ½″ (=2″), the nails will project ½″ at the back; the board should then be turned over, and so placed that the head of each nail in turn may rest on the head of the axe, laid flat on the bench, or on some other piece of iron; the end of the nail is then to be clamped or turned over. To do this properly, begin by striking the nail gently on its point until it bends to form almost a right angle with the length of the nail, which is then to be struck sideways, so that it may bend at a point close to the bottom; and thus the bent point being driven

into the wood, it will be impossible, without breaking the nail, to pull it out from the other side. The amateur should aim at bending the nail only at the points intended, without causing the parts to be curved; for, if this is the case, a blow struck on the curved part causes the head of the hammer to be forced partially forward again, by which means its tightness is diminished. Two nails should pass through each of the blocks; but, in order to avoid all chance of splitting the wood, the nails should not be in the same perpendicular line. Instead of nails, screws may be used, holes being previously bored to receive them. When the end and middle blocks have been thus secured, the intermediate ones are to be fixed in their places. The edges of the back-board should be planed off as already described.

The method of fixing the rack in its place must now claim attention, and this must be regulated by the construction of the wall; for if the room be panelled, the rack may be screwed to it, and, in this case, if the panels are edged with mouldings, blocks must be placed at certain distances, so that the surface to which the back-board is to be screwed may be of the same level as the mouldings; or the rack may be made in parts, so as to be affixed to the panel inside the moulding. This is mentioned because in our old country mansions there are some beautiful rooms, which, owing to the modern additions to the building, are left unused, and are thus likely to afford good accommodation to the gentleman carpenter. If the occupation of such a room be only temporary, the rack may be simply hung against the wall by means of two picture-rings and screw-hooks.

As a general rule, however, the walls would be of brick, plastered; and in fixing the rack, or indeed in placing nails at all in such walls, the greatest care is required in order to avoid the annoyance caused by the nail allowing itself to be driven an inch or so, then the sound of the hammer changes, and as the blows are repeated the surface of the wall around the nail bulges up, and at last a quantity of plaster

falls out. Then the cause becomes evident—viz., that the nail has been driven against a brick, instead of into a joint between two, and, not being able to penetrate, has curled up against the brick, and forced out the plaster.

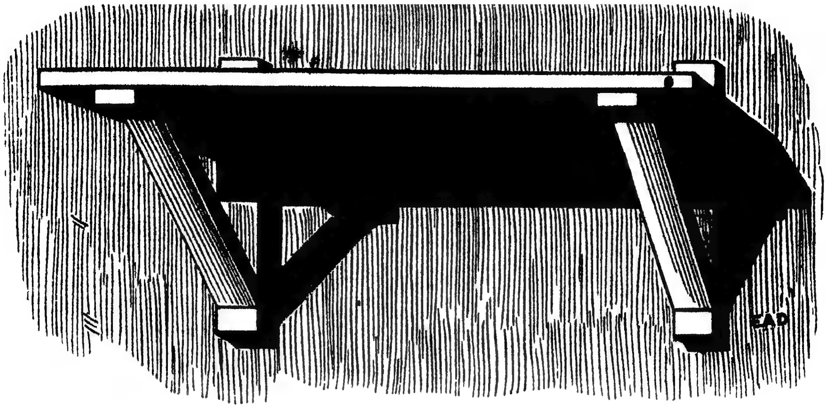
It is, therefore, necessary to probe the wall, in order to find a joint. This is done by driving an exceedingly fine brad-awl into it by means of the hammer. If the point strikes against a brick, this will soon be evident, both by the sound and by the resistance. If the steel of the tool is driven in up to the handle, it is certain that it has entered a joint. This point is to be marked, and a horizontal line drawn from it, and on this the wall is to be again probed at different distances, for the brad-awl may have entered a vertical joint between two bricks, in which case it would not be certain that a spot on a horizontal line with the former might be found at once, as would be the case if the tiny hole made by the brad-awl were made in the horizontal joint. As it is necessary for a subsequent purpose to be certain on this point, another hole should be struck at about 2″ from the first one, and in an absolutely horizontal line with it; and if the brad-awl sinks entirely into this one as well, it will be certain that both are in a horizontal joint.

Now, it is not sufficient merely to attach the rack or anything else to a brick wall by simply driving the nails directly into the joints, for they very soon become loosened, and the whole structure would then fall down. It is, therefore, necessary (to use a technical term) to "plug" the wall.

This is done in the following manner: Having made sure that the points at which the nails are to be driven are in horizontal joints, the little holes made in probing are to be very much enlarged by means of a chisel—not one of those used for woodwork, but of the kind used by masons or bricklayers. This must be done without more than the necessary damage to the surface of the wall. A space of about 2¼″

having thus been cleared of mortar, a wedge of wood, about 3″ or 3½″ long, is to be driven very tightly in, its end being cut off so as to be perfectly level (or, as it is termed, "flush") with the surface of the wall. The plugs are shown at A and B, Fig. 12. The rack is now to be held up against the wall, and holes bored through it immediately over the plugs, and it is then to be nailed up.

When it is known beforehand that woodwork, such as wainscotting, or window-framing, &c., is to be attached to the brickwork, blocks of wood, called "wood-bricks," are built in along with the bricks, or pieces of wood of the thickness of the joint are at once inserted, and to these the necessary frames or boards are nailed.



TO MAKE AND FIX A SHELF.

(Fig. 13.)

A Shelf is an indispensable adjunct to a workshop, for of course, planes cannot be put in the rack, nor can they remain on the bench, which should always be kept quite clear. The best plan therefore, is to put up a shelf or two, on which the planes, boxes of materials, &c., &c., can be conveniently placed, remembering always that planes must never rest on their underneath surface or sole, but must always be laid on their side.

Now, it is desirable at the outset to impress on the minds of amateurs that whatever is to be made, or whatever is to be built, the work must be done in a strong and workmanlike manner. It must not be thought that because the shelf is to bear the small weight of a couple of planes, it need be only made in a slight or careless manner. A shelf once in its place, there is no knowing what may at any time be put upon it, and the annoyance of a shelf falling down, and the damage which may be caused thereby, may be serious—so serious, in fact, that the idea of a plane or two coming down on one's head whilst at work at the bench is one too painful to contemplate, inasmuch as such a mental picture might go a long way to deter the amateur from taking

up an occupation in which he would otherwise find pleasure. A shelf, then, should be supported on brackets. If the wall be of wood, iron brackets may be employed, and these require simply screwing against the boards; and even for a brick wall, cast iron ornamental brackets may be purchased, but these require building into the wall—a work far beyond the sphere of a gentleman carpenter. The best plan, therefore, is to make a pair of wooden brackets, and, of course, there is a right way and a wrong one of doing this; but, strangely enough, the wrong way is that most generally followed, and we show this here, in order to point out why it is wrong in principle, and how it becomes merely a question of a few weeks' time, or a few pounds' weight, whether it shall stand or fall.

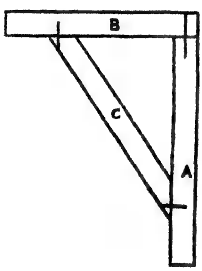


Fig. 14.

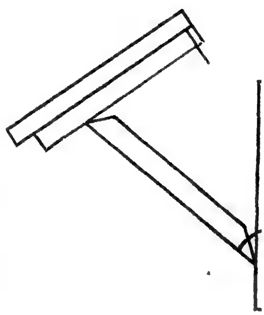


Fig. 15.

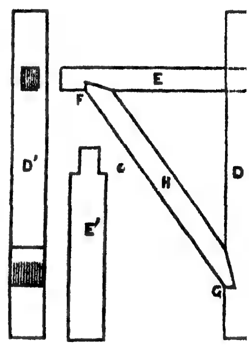


Fig. 16.

Fig. 14 is a side view of the bracket we often see made, not only by amateurs, but by "handy men," so often employed to do odd jobs, but the result of whose exertions is really to provide work for proper artizans. It consists of a straight piece (A), on the top of which another piece (B) is nailed, and this is supported (?) by the strut (C). Now, this strut is cut slantingly at its ends, and nails are driven into its thin part, thus attaching it by its weakest points, which are either split in driving in the nails, or when weight is put near the edge of the shelf. For as the

horizontal B is only fastened to A by means of a couple of nails running parallel with the fibres of the wood, which, therefore, offer little resistance, the piece of wood B really acts as a lever to draw out these nails, and the result is shown in Fig. 15.

The objects to be accomplished are, then, twofold: the bracket must be so constructed that the near end must be prevented pressing downward, and the distant end must be secured against upward tendency. The following sketches will show how these ends may be accomplished:

Provide some good clear pine wood 2″ wide and 1″ thick, and cut from this the back-piece, D, Fig. 16. The length of this, of course, cannot be given here, as it must depend on the size of the intended shelf; it must, however, extend about 3″ above the surface of the shelf, and about 3″ below the insertion of the strut.

At 3″ from the top cut a hole 1″ high and 1″ broad. This may in the first case be set out by drawing, by aid of the square, a line across the wood at 1″ below that marking the position of the hole. There will then be two lines across, viz., one at 3″ and one at 4″ from the top. Then, by means of the gauge, mark a line on each side at ½″ from the edge, which will leave the form of the hole, viz., 1 × 1″, which is to be cut out with the broadest mortising chisel. To do this, hold the chisel perfectly upright, the flat side towards you, and strike a couple of blows. Then strike the chisel from the opposite direction, so as to free some of the wood; and repeat this process on the lower side of the hole. A hole like this may also be done with a broad paring chisel, instead of the mortising chisel; or two ½″ holes may be bored with the brace and bit, the aperture thus formed being afterwards squared with the chisel. This part is illustrated in D′.

The horizontal, E, is now to be cut to its required length, and be shaped at its end like Fig. 16, E′, a piece 1″ long and ½″ wide being taken from each side of the end, thus leaving a tenon 1″ wide and 1″ thick, which will precisely fit into the mortise made in D. Place

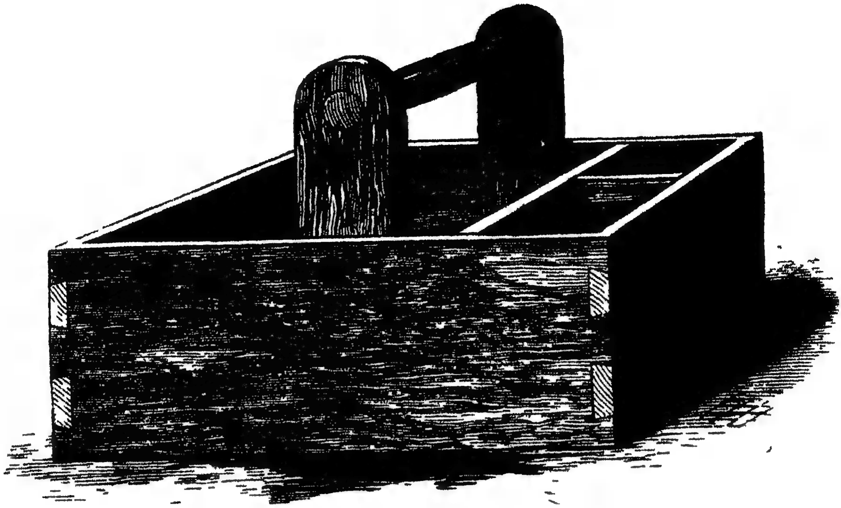
the tenon temporarily in the mortise, and from the angle at which the two pieces of wood meet, mark on each (F and G) the points to which the strut is to extend, ruling lines across. Having carefully ascertained that the two pieces are at right angles with each other, place the third piece edgewise from F to G, and mark the length it is to be, allowing rather more than ¼″ extra on each side, which is to be sawn off, so as to blunt the end, as shown at F and G; for if the ends were left sharp, they would have the tendency to split, and would not give the support which they give when cut off at right angles to the surface of the pieces against which they are to abut. Saw across the upright and horizontal pieces at the places where the strut is to be fixed, making the cut ¼″ deep, and from the exact points where the strut crosses the two pieces on its inner side, slant the surface with the chisel to meet the previously-made saw-cut, subsequently shaping the ends of the strut accordingly.

The parts being now ready are to be put together. Insert the tenon once more into the mortise, having previously made a couple of deep saw-cuts near its sides. When in its place, two wedges, made of beech or some other hard wood, are to be hammered into these cuts, by which the tenon is extended without being split. When this is done, the joint may be additionally strengthened by a screw, 1½″ long, driven from each side. These screws should, however, not be exactly opposite to each other. Now lay the bracket on its side, and press the strut into its place edgewise. With the gimlet bore two holes at each end at right angles to the surface of the strut, and the apertures having been slanted at the top by means of the "bit" made for that purpose, screws are to be inserted and to be driven well home. It will be seen that in a bracket thus constructed the upward tendency of the one end and the outward tendency of the other are counteracted.

The construction of this important support has been thus dwelt upon as it can be used for so many purposes. It need not necessarily be the three straight pieces of pine here shown, but may be made of oak,

mahogany, or other wood. Its edges may be splayed, and its ends may be carved. The strut may be curved, and the spandril (or aperture between the strut and the angle) may be filled with a pierced or carved panel; in fact, so long as the structural arrangement is correct, the decorative may be made to suit the taste of the amateur, who should, however, remember that ornamentation should always be subservient to construction. If the strut is to be curved, it should be cut so that the fibres of the wood run in the direction of the length, not crosswise.

The shelf should in the first place be well planed on both sides, on the front edge, and on the ends, and when the brackets have been nailed to the wall, it should be laid temporarily upon them, and brought close to the wall: if it should be found that the surface is not perfectly straight, the exact shape should be marked on the shelf, the edge of which should then be planed, so as to fit to the inequalities in the wall: it should then be screwed to the brackets.



A PORTABLE TOOL-BOX OR TRAY.

(Fig. 17.)

The power of executing various little repairs about the establishment is one of the pleasures arising from a knowledge of carpentry and joinery. We all know how true is the old adage that "a stitch in time saves nine," and we know, too, that if we live in the country, we have, in the first place, to wait until we go to town, then to see the master builder, who promises to send a man (at our expense) to see what is wanted. The man comes, he looks at the "job," says he quite sees what is wanted—which, considering that it is only a trifle, he could very well have understood from the description we gave, is not very wonderful—and that he will come to-morrow and do it: a half-day, or perhaps more (trains run so very irregularly to some places) is thus wasted in the diagnosis of the case, and in the course of a week, the man—or another, who has again to go through the inquiry—appears; the work is accomplished, after occupying the day, the expense of the whole being enough to purchase a very nice little collection of tools, with which it is most likely that a gentleman

having the smallest development of constructive powers could have executed the little repairs himself.

The method of making and fixing a tool-rack has been described, but this is, of course, only useful in the workshop, and the present appliance is suggested in order to enable the amateur to select just such tools as he may require for his purpose in any room in the house or at any part of the grounds where the scene of his operations may be.

The Tool-tray is merely a strong shallow box, and the following are the dimensions :—The two long sides are to be 16″ × 6″, and the two short sides 10″ × 6″, the wood being pine ½″ thick. The sides are to be united at their angles by what is called the dovetail joint.

Dovetailing is the method of fastening pieces of wood together by projecting pieces cut in the wood, somewhat after the form from which they derive their name, which are made to lock into recesses of precisely the same shape in the other. Dovetailing is of three kinds—Common, Lap, and Mitre. Our present business is with the first; the others will be described as occasion may require their application.

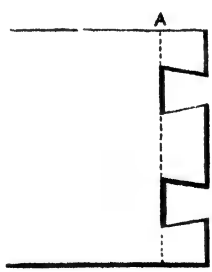


Fig. 18.

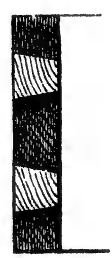


Fig. 19.

Fig. 18 represents the end of one side. Draw the line A at ½″ from the end. Within this space the dovetails are to be cut, the sides being sawn with the tenon or dovetail saw, and the roots being cut with the chisel, the angles being accurately cleared, and the sides being kept perfectly at right angles with the surface of the board.

Fig. 19 shows the form in which the ends of the sides to be united to these are to be cut, the recesses corresponding precisely with the projections on the other side, and they must, of course, be just ½″ deep. A few nails are to be driven through the tongues, so that the one part may not be drawn away from the other.

The sides being thus united, the next consideration is the bottom; and as the contents of the tray will be rather weighty, this must be so fixed that it will not be forced off, of which there would be a chance if it were simply nailed on outside; besides this, it is possible that the tray may be taken out of doors and placed on the ground, from which damp may cause the bottom to split, and the tools thus become injured by rust. The following construction will prevent both these results:

Prepare four strips of wood ½″ square, and having cut them to exactly the required lengths, nail them round the bottom of the sides on their inner sides, thus forming an internal ledge. The bottom is to be cut precisely to the size of the inside of the tray, and is to be dropped in until it rests on the ledges; it is then to be secured by nails driven in from the sides.

In order that a supply of nails and screws may be taken with the tools, a couple of compartments are to be made at one end of the tray. One of the walls of these should extend across the whole width of the tray, being attached by nails driven from the sides; or it may be fixed to ledges glued or screwed against the inner sides of the walls. A piece of board placed crosswise will divide the long compartment thus made into two smaller ones, or any greater number may be made to suit the wish of the amateur constructor.

The handles are to be made out of wood 2″ wide and 1″ thick, and they are to be 8″ long. It is advisable to cut a piece of wood 16″ long, draw a line across the middle of it, and cut a hole at ¾″ on each side of this line, with the brace and bit; these holes are for the subse-

quent reception of the rounded bar which is to form the handle, and which is to be at ¾″ from the top: the tendency to split when a large hole is cut near the end is avoided by making it whilst the parts acted upon are in the middle of the wood, and they are afterwards to be sawn asunder. The holes are to be cut with the ¾″ bit.

When the two parts have been severed, the tops are to be rounded, and a horizontal cut is to be made across each of them at 5″ from the bottom and ½″ deep, the wood below this saw-cut being removed. This will be best done by means of the tenon-saw, as, if removed by the chisel, the wood might split in the direction of the fibres, which might not run exactly parallel with the edges, and it is necessary that the surface should be perfectly level.

The handle itself is to be made of a good piece of wood, and is to be rounded first with the drawing-knife, then with the spokeshave, and finally finished with sandpaper. It is not to be perfectly cylindrical, but may be thicker or swell towards the middle until it reaches about 1″ in diameter. This will make it more convenient to grasp, and will, at the same time, add to its strength. It should be glued in the holes in the supports, which are now to be fixed in their places. As the lower part of these is ½″ thick and 5″ long, it will reach exactly from the edge to the bottom of the tray—the sides of which are externally 6″ deep, but of which depth internally ½″ is taken up by the ledge, and ½″ by the thickness of the bottom; and as the thickness at the top of the standards is 1″, they will cover the edge, and will be flush with the outside of the tray. They are to be fastened with ¾″ screws.

TO BUILD A CUPBOARD IN A DRESSING-ROOM.

(Fig. 20.)

A good-sized cupboard fixed in the corner of a bed-room or dressing-room forms a very useful addition, even though a wardrobe is already one of the articles of furniture; and it is here made one of the earliest subjects, as, from the simplicity of its construction, the amateur is pretty sure of successfully accomplishing his purpose.

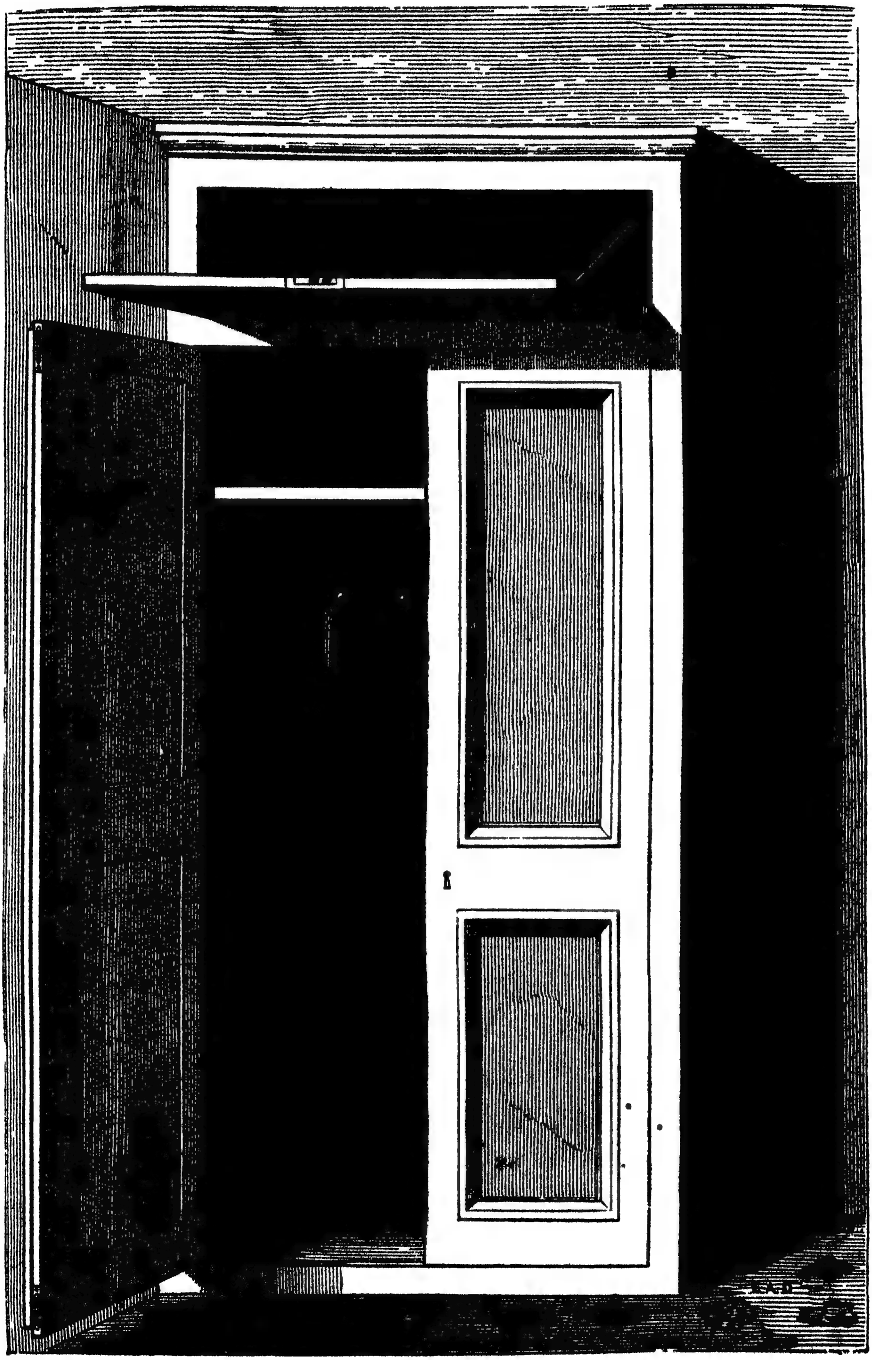
The dimensions of most of the objects described in these pages must of necessity be left to the decision of the amateur carpenter, since the position, the space at his disposal, and the precise purpose in view must, of course, influence the sizes. The method of working, the principles of construction, &c., will, however, remain the same.

We will then assume the height of the room to be 9′ 0″, and that the cupboard is to be placed in the left-hand corner. The width of the front of the cupboard is to be 4′ 0″, and the depth 1′ 4″.*

Such cupboards are not, as a rule, built the whole height of the room, but leave a flat top on which various articles—hat-boxes, &c.,—are usually stowed away; but this gives the room an untidy appearance, and space is often devoted to valueless things which might be used for storing papers, books, &c., which, although of consequence, are not frequently wanted. We purpose, therefore, carrying our cupboard quite up to the ceiling, with a separate horizontal compartment at the top.

In the first place mark in pencil on the walls and floor the exact position, vertically and horizontally, of the intended structure. Then having duly "plugged" the wall, nail a strip of wood, about 2″ wide and 1″ thick, at a distance of 1′ within the lines of the front and side of the cupboard.

These lines will, on the wall on the one side, be at 1′ 4″ from the angle, and on the other, 4′ 0″. The strips are, therefore, to be nailed at



CUPBOARD WITH SEPARATE COMPARTMENT.

1′ 3″ and 3′ 11″, to allow for the thickness of the front and side. Similarly strips are to be screwed to the floor and ceiling in lines continuous with those on the walls. Those on the floor will, of course, be very easily managed, but those on the ceiling will present a little more difficulty; and as the gentleman house-carpenter may occasionally be asked to put up a few hooks in the ceiling of the pantry or store-room, it is desirable to point out to him that there is a coating of plaster of about 1″ or 1½″ thick, and that, of course, it is not of the slightest use to attach anything to this, and that, therefore, he must penetrate beyond it.

But even then it must be remembered that the top of the room is formed of joists resting on the walls, and that to these (or to ceiling joists, which are smaller timbers notched on to the last-mentioned) laths are nailed. Now, even if the nails penetrate the plaster, they will still be of no service if they pass into the laths only; in fact, the very act of attempting to drive a nail into a spot consisting of laths and plaster only, will in many cases, owing to the elasticity of the surface, crack off the plaster. The ceiling is, however, easily tested, without even taking the trouble to probe it, for a tap or two of the hammer will draw forth a sound which will soon show whether the surface is hollow, as it would be if struck on the laths between the joists, or whether the blow has fallen on the joists themselves. Having, therefore, settled the line to which the strip is to be attached, and having bored holes in the wood at points which will fall on the joists, the strip is to be held in its place, and the largest bradawl being inserted in the holes in strip, the plaster is to be penetrated with this tool, which is, however, to be exchanged for the gimlet when the joist is reached. The strip is then to be screwed in its place: screws are preferable to nails, because it is most difficult for an amateur to strike a large nail upward.

Now, it has already been explained that there is to be an upper

compartment, and it is necessary, therefore, before commencing the cupboard itself, to prepare the necessary "fixings," which will consist of strips similar to those previously used for the attachment of the side and front of the cupboard, nailed to the two walls at the required height; and, as it is intended that the surface of the floor of the compartment should be 7′ 6″ from the ground, and as it is to be made of wood 1″ thick, these ledges must be nailed at the height of 7′ 5″.

Inside the cupboard, too, there is to be a shelf at, say, 6′ 0″ from the ground, and for this similar strips are to be nailed; and, further, as a rail furnished with hooks, on which to hang clothes, is also to be fixed, this should be nailed up at once, so that all the preparations may be made at starting, as it must be clear that it is far more convenient to do all the work which is to be inside the cupboard before the structure is fixed in its place than afterwards. And now we can proceed with the woodwork itself.

The front of the structure is, in the first place, a frame made of wood 1″ thick and 3″ broad. The two uprights are to be the full height of the room—in this instance 9′ 0″, but, for reasons to be presently explained, they should in the first case be cut about 6″ longer—and the three cross pieces—viz., one for the top, one for the bottom, and one for the division between the cupboard and upper case—are, in the first instance, to be cut the full breadth of the cupboard, viz., 4′ 6″.

The five pieces having been thus "got out" (to use a technical term), the next step is to prepare them for being joined into a frame.

The cross pieces are, in the first place, to be tenoned—that is to say, a tongue is to be formed at each end by reducing the thickness and width, so that it may fit into a mortise in the other piece. This tenon should be one-third the thickness of the piece; therefore, having set the gauge to the right size, mark the lines on the end and side of the part to be tenoned, and saw down and across in the marks so as to free a flat piece ⅓″ thick on each side, leaving the

tenon one-third of the thickness of the piece, and a piece is also to be removed at each edge, so that the tenon may be only 2″ wide. Now, it has been said that these cross pieces are to be 4′ 0″ long, but the tenons are not to be equal in length. The tenon which is to be inserted into the upright nearest the wall is to be at first 1″ too long, and the one at the opposite end is to be 1′ shorter than the width of the wood into which it is to be mortised. The following diagrams will assist in making the reasons for the foregoing clear.

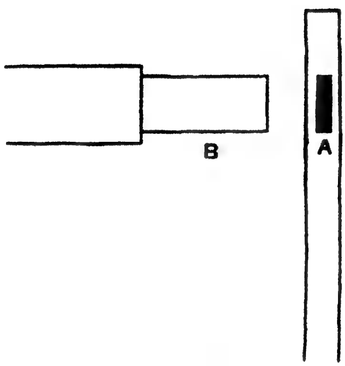


Fig. 21.

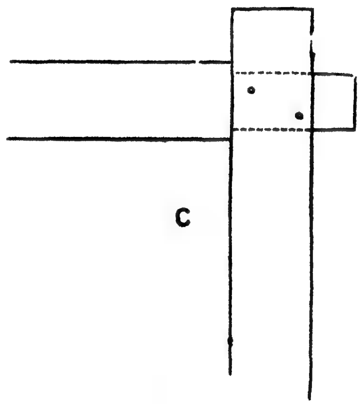


Fig. 22.

A, Fig. 21, shows the edge of one of the side pieces with the mortise; Fig. B shows the tenon; and Fig. C shows the two pieces *in sith*; and the reasons for making them too long will be clear: in the case of the upright, the mortise, being only 1″ from the end, would be very likely to split the wood, which accident will be prevented by making the piece an inch or two too long; and the splitting of the tenon in driving in the wooden pins is also prevented by the same measure. The tenon at the other end is to be only 2″ long, the distance from shoulder to shoulder—*i.e.*, the commencement of each tenon—being still 3′ 6″. Now, it will be clear that as the edge of the outer edge of the framing will be visible, it will be well to avoid, if possible, the tenon coming quite

through the wood, and this is accomplished by means of the FOXTAIL MORTISE. In this the mortise is cut rather wider at the bottom than at the top, the whole tenon being cut straight, just as broad as the top of the mortise. The tenon is then split with the chisel in several places, especially towards its outer edge. Wedges of hard wood are then to be inserted into these fissures, longer and thinner towards the edges than near the middle, and the tenon, with the wedges, is then to be inserted into the mortise, and as the framing is struck by the mallet,

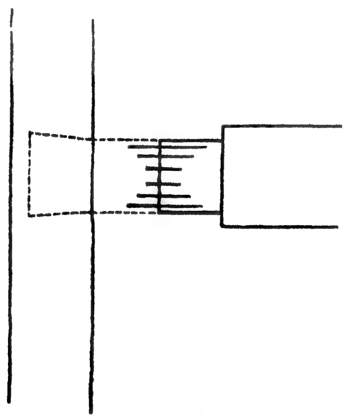


Fig. 23.

the outer wedges touching the bottom of the mortise are forced into the tenon, and split without breaking the edge of it. All the other wedges in turn come into play, and thus the whole tenon is expanded at its end, so as completely to fill the mortise, and efficiently to tighten the framing. The blows are not to be struck directly on the framing, but a smooth and flat piece of wood is to be interposed, so that the edge may not bear the marks of the blows.

The parts composing the foxtail joint are shown in Fig. 23.

The whole of these directions having thus been carried out, the side is to be made—we say *made*, because it must be glued up of two lengths. The joint should be that ploughed and tongued, the groove

in the one piece and the tongue on the other being done with the pair of match planes already described, the directions as to glueing being carefully attended to.

If the cupboard is to be painted, the front frame may be nailed to the edge of the side, which is to be 15″ wide. The nails must in such case be driven below the surface with the punch, and the cavity left in the surface must be carefully filled in with putty.

But it is by far better to preserve the natural surface of the wood, and several beautiful stains may be obtained, which, when coated with varnish, will make the cupboard very much prettier than it would ever become by painting. Information as to staining and varnishing will be given further on.

In this latter case nails must not be visible, and therefore the parts must be united from the inside. This is readily accomplished by screwing to the inside of the front, at 1″ from the edge, a strip of wood 1″ square, to form a ledge, against which the side is to be placed. Screws are then to be driven through this ledge at right angles to the former ones, and passing into the side, which is thus firmly attached to the front.

Again, if the cupboard is to be painted, it may be nailed to the ledges already fixed to the wall; but if it is to be stained and varnished, ledges must be screwed to the cupboard, from which screws must pass to those on the wall.

Before the front and side are put together, ledges must be screwed to the side, corresponding with those on the wall, for the support of the floor of the upper compartment and shelf.

These boards should be nailed in their places, supported on the ledges at right angles to each other on the two walls before the front and side are put up, as the trouble of getting them in through the framing is thus avoided. Their free end is afterwards to be nailed to each respective ledge in the side.

The main structure may now be assumed to be in its place. We proceed to the construction of the doors.

The doors are to be of the class called "Framed and Panelled." The upright parts of the framing are called "STILES," and the horizontal parts are called "RAILS:" upper, middle (or lock), and lower. These are to be tenoned and mortised together in the manner already described; but before the frames are put together, the inner edge of the upper and lower rails, both edges of the middle rail, and the inner edges of the stiles are to be ploughed with a groove ¾″ deep, ¼″ wide, running at ¼″ from the back, and thus leaving ½″ towards the front. The panels are to be made of ½″ wood, and are to be 1″ longer and 1″ wider than the space they are to fill. The edges are to be planed slantingly at the back until they are at their extremities rather less than ¼″ thick.

In commencing to put the door together, place the upper and lower panels in the grooves in the middle rail, and then add the upper and lower rails. Apply hot glue to the tenons at the ends, and insert them into the stiles, driving them closely home with the mallet, and subsequently securing the joint by wooden pins, which may be driven in at the back, not reaching quite to the front. The panels need not be glued in, and thus, as the grooves are rather deeper than required, the expansion or contraction which may take place is allowed for; whereas, if tightly fixed, the panels would crack. The pieces forming the framing are, as already explained, to be cut a couple of inches too long at each end, which may be neatly cut off, and the end smoothened with the plane when the doors are finished thus far.

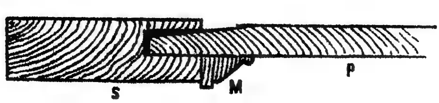


Fig. 24.

Fig. 24 is a section of one of the stiles, showing the insertion of the

panel—S stile, P panel, M moulding—which will be referred to presently.

The doors are, of course, to be "hung" by hinges, which must be sunk into both doors and stiles; they should be affixed first to the doors, which should then be held in their places whilst the holes are being bored in the stiles and the screws driven in.

The left-hand door when closed is to be fastened by means of bolts sunk into the perpendicular edge at top and bottom, to work into holes in the edges of the upper and lower rail of the framing; or if the door be a very long one, a bent bolt, screwed on inside and working into the under surface of the shelf, may be substituted for the upper bolt, by which the door will be rendered more firm for the lock to work into.

The lock should be of the kind called the "Inside Door Lock," and is easily fixed. It should, in the first place, be held in its place against the door, and by being pressed, the iron pin on which the key is to rotate will make a mark, which is to be bored through to the other side with the brace and bit; or if the exact spot at which the lock is to be fixed is not of consequence, this hole may be made from the front at once. It is then to be elongated downwards, so as to form the keyhole—an operation which is performed by means of the keyhole saw. A brass escutcheon may afterwards be fixed on the keyhole.

The doors at their line of meeting may either be made to overlap each other by ½", the outer half of the thickness being rebated in the one and the inner half of the other, or they may be made just to meet, and a strip of wood, planed half round, may be nailed on the door to which the lock is fixed, projecting by half its width, a bead or round moulding being planed on the edge with a beading plane. This will cover the line of meeting, and is easier to accomplish than the former plan. The top and bottom of this strip must be slanted off.

The door for the upper compartment is to be made in precisely the same manner as the others. It is to open horizontally, and in order to

prevent its overhanging the other doors, small chains should be fixed as shown in the sketch. A very convenient slab is thus afforded, which will be of use when moving some things in order to get at others. This door will require a "drawer lock." In purchasing locks, it is necessary to describe the positions they are to occupy—whether they are to work upward, to the left or to the right; for it will at once be understood that if a lock like that on the door below were placed on the upper door, the keyhole would be horizontal instead of vertical.

In affixing a drawer lock, sufficient wood must be cut away to allow the box of the lock, and the plate as well, to sink into the door, and when the lock has been fixed, a recess must be cut in the edge above, into which the bolt is to work. The amateur joiner who has proceeded thus far will find little, if any, difficulty in these minor arrangements.

The construction being now finished, the ornamentation by means of mouldings only remains to be spoken of.

It will, of course, be seen that the panels are set back ½" from the stiles and rails, leaving a sharp edge all round, which would present an ugly appearance, which may be entirely removed by the addition of a moulding, forming, as it were, a frame to each panel.

Now, in order that the four pieces of moulding forming the frame may fit accurately so as to form a right angle, they must be cut to what is called an "angle of 45 degrees," or half a right angle; and to effect this is a matter of some difficulty—which is, however, materially diminished if the proper method is adopted. This method consists in the proper use of a MITRE-BOX; and we must, therefore, in the first instance, show the method of making this most useful appliance.

The mitre-box consists of the floor and two sides of a long box. In the present case the floor is to be 2" wide, and the sides are to be 3"—the wood employed being 1" thick. The sides are to be strongly screwed to the long edges of the bottom, as shown in the end view—Fig. 25.

Fig. 26 shows the plan or view obtained by looking directly down upon the box. A B are the walls. Now, having previously marked the lines, C D and E F, at angles of 45° across the walls, and having carried

Fig. 25.

the lines perpendicularly down the sides, the tenon-saw is to be held perfectly straight in the lines C D and E F, which are to be sawn down to the floor. Great care must be taken that the saw travels downward absolutely in the vertical lines marked on the sides.

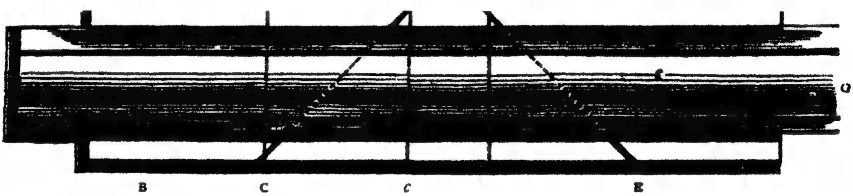


Fig. 26.

Now, it will be clear that, when a piece of wood or moulding is placed in the mitre-box, as shown at G, and the saw is worked in the "kerf" or groove, C D, the end of the moulding will be cut at 45° to its length, and the cut will be upright; and there is the additional advantage that a number of pieces will all be cut with equal accuracy—in fact, if the pieces are flat, several may be laid on each other, and sawn through by the same operation. The opposite cut for the other end of the moulding is shown at E F, and the complete mitre-box is illustrated in Fig. 27.

In order to mark the line, C D, with perfect accuracy, measure the

entire width of the top, viz., 4″, and set it off from C, viz., to *c*,—also from D set off the same length to *e*; then D *e*, C *c*, will be a square. Draw D C, which will be a diagonal of the square dividing the right angles into angles of 45°.

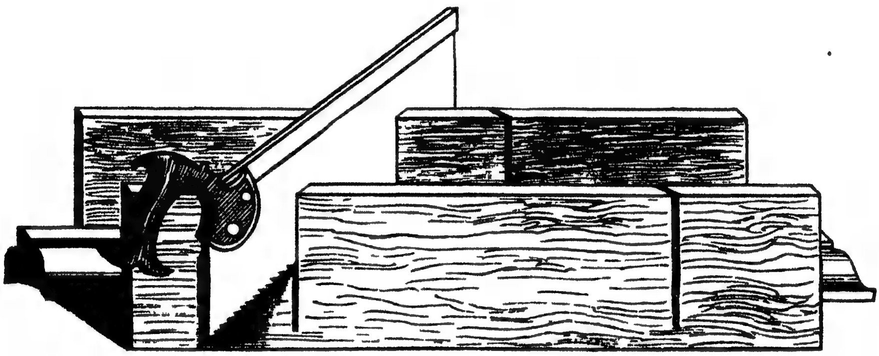


Fig 27.

The moulding should be firmly held against the distant wall of the mitre-box, and the saw must be worked with care, so that it does not in any way damage the sides of the kerf. If you do not happen to have a tenon-saw of the full depth of the mitre-box, a flat piece of wood may be placed under the piece to be sawn, thus forming, as it were, a false bottom; but a broad saw is to be preferred, as the deeper it sinks into the kerf, the more sure it is to be kept perpendicular.

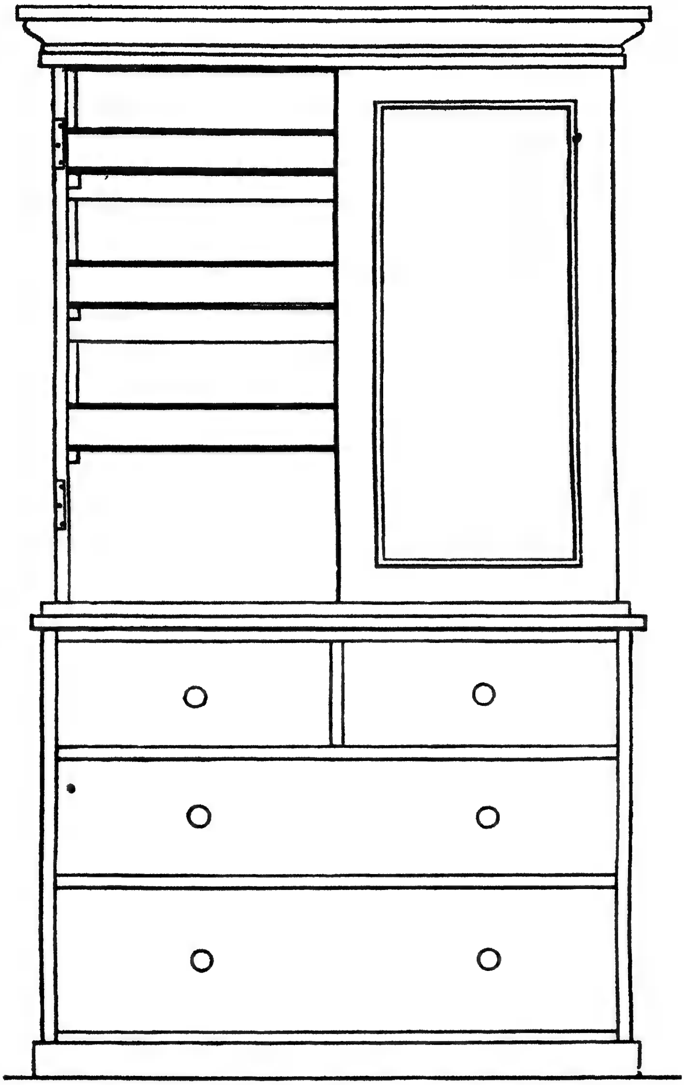
In use, the mitre-box may be placed against a piece of wood temporarily screwed to the bench, or it may be held in the bench-vice.

It will, of course, be understood that this system does not apply to the angle of 45° only, but that the kerf may be made so that any angle may be cut by its guidance; but it must be borne in mind that the angle at which the pieces are cut must be half of that of the form into which they are to be united: thus, supposing the moulding is to surround an octagonal panel, the ends of the pieces must be at 67½°, since the external angle of an octagon is 135°.

If the saw used is a fine one, the ends will not require smoothing; but where this is not so, or where wood has to be planed smooth at a given angle, a "Mitre Board" is used. This consists of a long board, at one end of which a piece cut to the required angle is fixed, and against this the moulding, the end of which is to be planed, is held, whilst the plane, resting on one of its sides, is moved along, guided by the edge of the mitre board.

The pieces, thus having been properly cut, are to be attached by glue, but are to be additionally secured by a few sprigs, which must, however, be driven in very carefully, so as not to injure the faces by blows of the hammer.

A moulding may also be carried round the top next the ceiling, so as to form a sort of cornice. Mouldings of an almost infinite variety of patterns may be purchased at a very trifling price. The whole cupboard may now be stained and varnished, or painted. Directions for both of these processes will be given farther on.



A GENTLEMAN'S WARDROBE.

(Fig. 28.)

In the subject previously given, the method of constructing a cupboard in a dressing-room has been shown. Such a cupboard is necessarily a fixture, and therefore the present wardrobe is constructed so

that it may be a separate piece of furniture; and not only this, but it is so designed that the parts may, in case of necessity, be separately used: thus, in the event of a room in a cottage having a gable roof not allowing of a piece of furniture of the height of 7′ being erected, the lower part may be used separately as a chest of drawers, whilst the other portion may be placed on low standards or brackets wherever it may be found convenient.

There is a great charm in furniture to which we have become accustomed. We grow to love an old table, which, at a sale, would fetch a couple of shillings. Why? Was it not at this table we sat, and toilsomely waded through our home lessons for the next day's school? Or was it not at this table a dear one, long since gone, used to write? Thomas Hood, in his "Remembrances," says:

> "I remember, I remember,
> The roses red and white,
> The violets and the lily-cups,
> Those flowers made of light;
> The lilacs where the robins built,
> And where my brother set
> The laburnum, on his birthday,—
> The tree is living yet!"

And even so there is before the writer at the moment when these lines are penned a table, at which his first literary efforts were made—at which letters were written to one who is the guiding star of his life—a table which subsequently was given to a dear brother. The *tree* is living yet—the *table* is here still.

And thus a piece of furniture made by ourselves, and made portable too, may be used in our own room in the old house at home—it may aid to furnish our room at college—it may travel with us to the most distant region of the earth; but memories will cling to it, and though only a wardrobe, we shall remember the faces of those who were used to place our clothing in it, or to rail at us for our untidiness.

We shall conjure up the scenes in which we were about to join when we called in the aid of the contents of those drawers, and in every memory we shall find either the "only friend that grief can call its own," or the pleasure that springs from the knowledge that we are but temporarily separated—either that "they are coming with the flowers" to join us, or that a few short weeks hencc we shall lift the upper from the lower portion of our wardrobe, consign it to the steamer or luggage-van, and return to them.

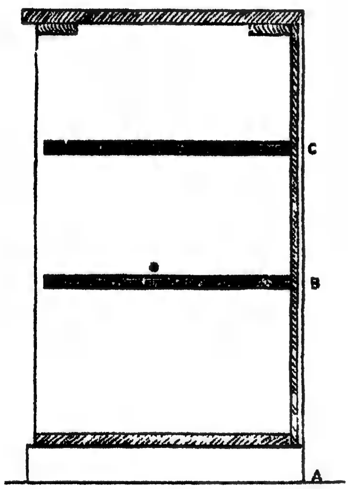


Fig. 29.

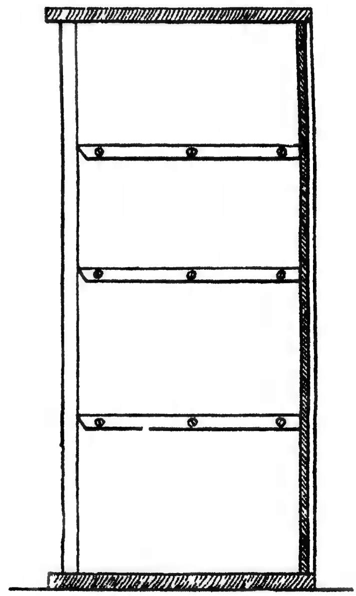


Fig. 30.

So let us to work, and let us try to construct a piece of furniture which shall fulfil the given conditions.

The lower portion, Fig. 29, consists in the first place of a case, 4′ 0″ wide, 3′ 0″ high, and 22″ deep, and this stands upon a plinth or pedestal 3″ high. It is to project ½″ in the front and ½″ on each side; and, as the rectangular base of the lower case, which is to stand on it, is 4′ 0″ × 1′ 10″, the pedestal must be 4′ 1″ × 1′ 10½″—that is, ½″ additional on

each side and ½″ in the front—the case being flush at the back; and it is to be made of wood 1″ thick. The back and front-pieces of the pedestal are to be of the full dimensions, viz., 4′ 1″ long; but the two end-pieces are to be 1′ 10″, being ½″ shorter than the width of the pedestal. This is caused by the fact that the sides are to be united by the "lap" dovetail already mentioned. By this method the tongues or dovetails do not pass through the sides, but are hidden by a ledge.

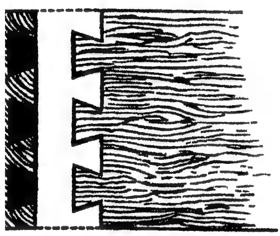


Fig. 31.

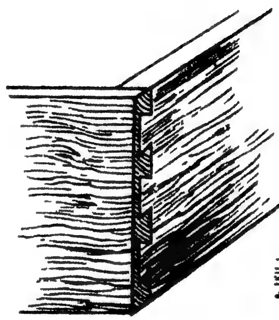


Fig. 32.


Fig. 33.

Fig. 31 shows the form in which the ends of the back and front pieces are to be cut, the shaded recesses being made sufficiently deep to admit of the dovetails or tongues of the side-pieces sinking into them; and Fig 32 shows the pieces when put together. It will thus be seen that the thickness of the ledge in this case, ¼″, reduces the ends of the sides thus much. The dovetails on the side-pieces are to be ¾″ long. This pedestal will not require any top, but should be braced together by a couple of cross-pieces united to the sides by what is called a "dovetail notch," shown in Fig. 33. The lower case will then stand on this pedestal, leaving a projecting margin of ½″ on the front and two sides—the rest of the thickness being under the case.

In commencing the case under consideration, prepare, in the first place, the two sides, which are to be 2′ 11″ long and 1′ 10″ wide, and should be made of 1″ boards. The width will have to be glued up of

two or three boards, which should be ploughed and tongued together. Having then nicely planed these, rule lines across the inner side, as shown in Fig. 29. The first space (A), of 1″ in height, is for the bottom of the case, which is to be joined to the sides by the lap dovetail, so that the ends of the tongues may not be visible at the sides; and a similar method of construction is to be followed at the top, where the sides are to be united by two pieces of the same length as the bottom, fastened by the dovetail notch, secured by a couple of screws in each. The bottom should be 1″ narrower than the sides, so as not to come quite to the back; and the back cross-piece at the top should also be set back 1″, for a purpose which will be shown presently.

Before, however, the bottom or the last-named pieces are joined to the sides, the lines across are not only to be ruled, but those at B and C are to be cut with the tenon saw, and the wood between them is to be removed, so that grooves, ¾″ wide and ½″ deep, may be made. These grooves are to cease at ½″ from the front. When these have been duly cut, and when the carcase of the case has been put together, boards, ¾″ thick and 1′ 9″ wide, are to be prepared. A piece of exactly ½″ square is to be cut out of each corner of the front edge, and having placed the case on its front, these boards are to be pressed into the grooves from the back—the ½″ recesses affording space for the piece left at the extremity of the groove, and allowing the edge of the board to come flush with the upright edges of the sides.

These boards are to form the division between the drawers. The writer is aware that in some pieces of furniture the drawers are made to run on merely a ledge of wood in the front and another on each side; but this is a most unsafe method, for thus, should one drawer be broken open and taken out, access would be obtained to the drawer beneath, the contents of which would at once be exposed; whilst, by the plan here laid down, the utmost safety is insured.

The divisions, the cross-piece, and the bottom, will all, if the measure-

ments have been accurately followed, be found to be set back 1″ from the back edge of the sides. The back, made up of ½″ boards, ploughed and tongued together, is to be nailed to these, and a narrow strip of about ½″ square nailed all round—thus not only securing the edge, but serving also effectually to exclude dust.

The top is next to be made of 1″ board; it is to project 1″ at each end, and 1″ in the front, and must therefore be 4′ 2″ × 1′ 11″. The edge of the front and ends may be rounded off with the plane, or a half-round bead moulding may be nailed to it.

The drawers must now occupy the attention of the amateur workman. In the first place, the upper space must be again divided by a partition so as to accommodate two drawers. The space from inside to inside of the sides of the case is 3′ 10″, and the partition is to be made of wood ¾″ thick, of which thickness half will extend on each side of the centre line; each of these upper drawers will thus be 1′ 10⅝″ wide, whilst the two lower ones will be 3′ 10″. The drawers should extend nearly to the back; the sides are to be made of wood ½″ thick, whilst the fronts should be ¾″ stuff. The sides should be attached to the fronts by the lap dovetail (shown in Fig. 32), in which the tongues of the side are shortened, so that they are not visible in front), and to the back by the common dovetail. A ledge of ½″ square wood should be nailed around the inside of the sides flush with the bottom edge; on this the bottoms are to be dropped from the inside, and are to be attached by sprigs. The depths of the drawers are shown in Fig. 29.

The handles may be either knobs made to screw into the front, or they may be brass flush handles, viz., such as on hanging down sink into recesses in the plates to which they are attached. The locks are to be drawer locks like the one used for the upper compartment of the cupboard (Fig. 20).

The lower case having been thus completed, the upper one can be proceeded with. The two sides of this case are to be 4′ 0″ high and

1′ 8″ deep. The top and bottom are to be 4′ 0″ long and 1′ 10″ broad. The sides are to be fixed to the top and bottom by mortises, and are to be placed at 1″ from the ends, and 2″ from the front of the top and bottom, the edges of all being flush at the back. Oblong mortises are to be cut in the top and bottom to receive tenons cut in the sides, and thus the interior height of the case will be reduced by 2″.

Before, however, putting the sides together, rule lines across so that the height may be divided into spaces of the following heights, 13″, 12″, 11″, 10″, and immediately below these lines screw strips of hard wood—such as oak, beech, or birch—about 1″ square, to serve as ledges in which sliding trays are to run. These ledges should be 1′ 6″ long, and should be so placed that they may be 1″ from the back and 1″ from the front, the end nearest the front being slanted off, and the edge of the long side being smoothened off by the plane. Great care must be taken in screwing these ledges in their places so that the screws may not be driven through the wood of the sides. The screws should be 1½″ long, their heads being countersunk into the ledges. In a very good piece of workmanship the ledges would be partly sunk in grooves cut in the sides. This plan adds materially to the strength, but the one already suggested will, as far as the amateur is concerned, answer every purpose.

The ledges then having been screwed on, the case may be made up. Care should be especially taken that the tenons do not protrude, in however small degree, beyond the surface of the bottom, in which case they would cause the case to stand unsafely, besides scratching the top of the lower case, which, in case it may at any time be used separately, it is desirable to protect.

It will no doubt have struck the amateur who is following these instructions, that the top and bottom project 1″ on each side, but 2″ in the front, and this apparent discrepancy will be removed when it is explained that the doors will be 1″ thick, and will thus take up half

of the projection, leaving then a rim or border of 1″ on the front and sides.

The back is to be made of ½″ boards ploughed and tongued together; it is to be nailed from the back to the ends of the ledges and to strips previously nailed on the top and bottom. A ledge of ½″ square wood is then to be nailed all round at the back.

The reader will, it is presumed, scarcely require any instructions as to the doors, which are to consist each of a frame and one panel; they are to be made in precisely the same manner as those of the cupboard previously described, the bolts of the left-hand door running into the projecting part of the top and bottom, and the hinges being screwed to the front edge of the case and the inner surface of the doors—not to the edge, as the doors are to cover the edges of the case.

The sliding trays are next to be made, and these are to be uniform in size. It will be remembered that the length of the bottom of the case is 4′ 0″, and that the sides of the case, which are 1″ thick, are to stand at the distance of 1″ within the ends. The inside of the case will thus be 3′ 8″, and this will of course be the length of the trays, with the understanding, that as they are to move freely in and out, they must be just a trifle less, but not sufficient to cause a difference in their written measurement, for if a real difference be made and too much freedom be allowed, they will be liable to shift more to one side than the other in drawing out, and sometimes get fixed, owing to their oblique position. The height of the sides is to be 9″, and they are to be shaped either with the drawing-knife or with the turning-saw, being afterwards finished with the spokeshave and sandpaper. They are to be united to their backs by the common dovetail, and to the fronts by the dovetail (the method shown in Fig. 31); the sides are to be 18½″ long from back to front, of which length ½″ will be taken up by the lap. The front end of the sides is to curve downwards to the width of 2″. The front is to be 3½″ wide, of which ½″ is to rise above the

ends of the sides, and 1″ is to fall below them; and thus, when the tray is in its place, the ledges will be hidden. This is shown in Fig. 34.

Strips of wood ½″ square are to be nailed round the inside of the shelves flush with the lower edge of the sides and back, but 1″ from the lower edge of the front; and on these the bottoms of the trays are to dropped from the inside and nailed down.

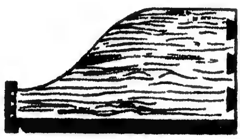


Fig. 34.

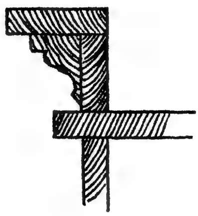


Fig 35.

Fig. 36.

It now only remains to make a cornice for the top of the case, and this can be effected in the following manner: Make a frame 3′ 10″ × 1′ 9″ of wood ¾″ thick and 3″ wide: the wood to stand on its edge—the four pieces being dovetailed together. On the upper edge of this frame is to rest a border made of wood, 4″ broad and ¾″ thick. This, however, need not be made in the form of a frame, as it is not required at the back. It simply consists of three pieces lying horizontally on the frame, and these must be cut at angles of 45° at the corners, where they are to meet; and they may be fixed by nails driven downwards into the frame and obliquely into each other. Under this projecting border a moulding is to be nailed, and thus a very neat cornice may be made.

The plan here shown is the simplest that can be adopted by the amateur, but a better cornice may be made of broad pieces of mouldings, which may be purchased ready struck. These pieces are to be placed slantingly, as shown in Fig. 36, and mortised at the angles.

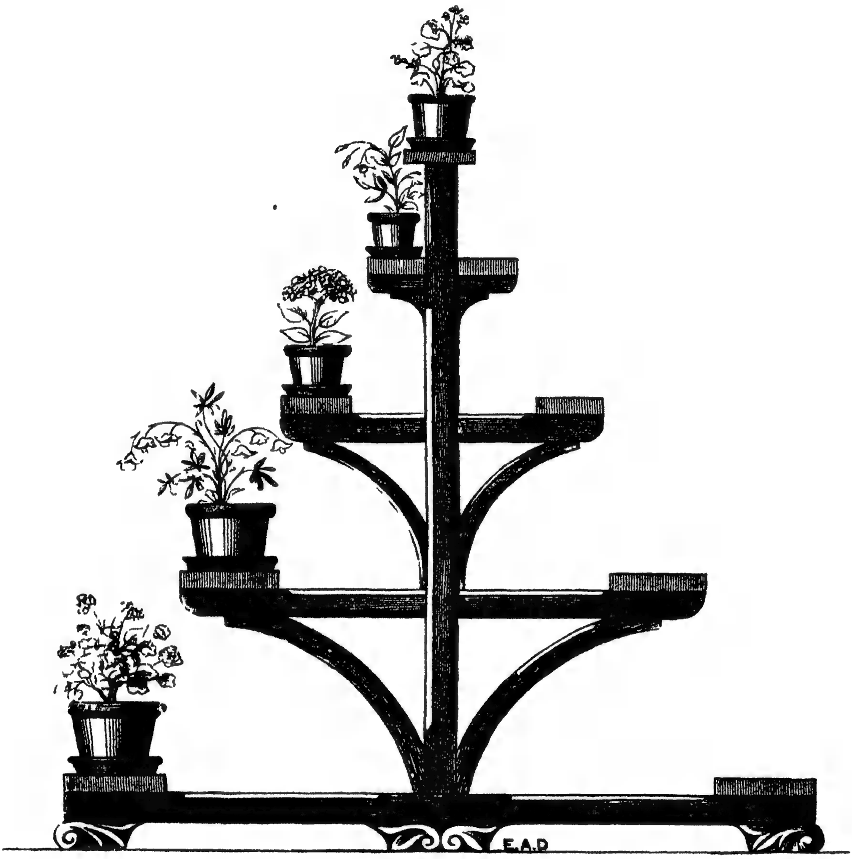
The method of making a gentleman's wardrobe having thus been

described, an amateur will require but few instructions to make one adapted for a lady's use. The following general directions will serve as guides:

The structure should consist, in the first place, of a plinth or pedestal, on which should stand two high cases screwed together to form one, which will thus be divided into two vertical compartments. Of these, the one should be supplied with pegs or hooks for hanging dresses; the other should contain at the bottom a deep drawer for bonnets, and then a series of sliding trays. A third case should extend horizontally over the other two, and this should contain one large sliding tray. On the top of the whole a cornice as already described should be fixed.

The doors will of course extend the whole height of the wardrobe, and may either be made of two panels each, as in the case of the cupboard previously described, or one panel may occupy the whole length. Further, this panel may be made to serve only as a back board, a sheet of looking-glass being placed in front of it.

A wardrobe thus made, painted with four coats of good white paint, and well varnished, the mouldings gilt (purchased in lengths at a very low price), the hooks gilt, with china knobs, the edges of the tray painted white with a gilt moulding, and who shall say what will be the gratitude of the fair recipient? The cost will be about a quarter of the shop price: the labour must not be counted, for it will be pleasure; whereas the gratification and comfort conferred will be infinite. It will lead one to the reflection, "Who would not be an amateur house carpenter?"



A STAND FOR FLOWER-POTS.

(Fig. 37.)

This is an exceedingly pretty and useful article of furniture, and may be made of any convenient size to suit a landing or centre of a room, or may be made on a much larger scale for a greenhouse or conservatory. The house carpenter must in all these cases be guided by the requirements in the measurements he may adopt in the timber used. It must be remembered that a number of flower-pots filled with earth,

and standing in earthenware saucers, constitute a heavy weight, which must be duly supported; but the amateur will do well to bear in mind this principle, that more strength can be obtained by proper construction than by thickness of wood. He will thus be led to think where the bearing-points really are, and will study how to support these. Nor should beauty and lightness of design be neglected. "A thing of beauty is a joy for ever" has not only been written by Keats, but it has been repeated by every one who has spoken on art, from the Royal Academicians down to Mr. MacSmudger, so it must be true; and it is true, in spite of the fact that the illustrations of the latter class of professors has done much to destroy the very theory they were intended to prove. And when we come to speak of flowers, in themselves the very emblems of all that is lovely and beautiful, we are led, as it were, unconsciously into a groove of refinement, and we come to the conclusion that the widened step-ladders which are called flower-pot-stands are not the prettiest things in the world — that the flat, slanting sides are not in consonance with the horizontal shelves and the upright growth of the plants which are to rest in them, and that a bright green flower-stand and rouged flower-pots cannot possibly have been in good Keats' mind's eye when he wrote the lines so very often quoted.

Our object, then, must be to combine lightness and elegance of appearance with strength, and we may also add another advantage at which we shall aim—viz., portability—so that the stand may be taken to pieces and moved from any room or landing to another, or that it may be put out of the way during a season when it may not be required.

The first parts to be made are the two standards; we say two, but it will of course be understood that others will be required to be placed between these if the stand is to be made of a larger size than is here proposed. The lowest horizontals and the uprights are to be made of

wood 2″ square. The horizontal is to be 3′ 10″, and the upright 3′ 4″ long, the latter being mortised into the middle of the former by a tenon 2″ long; also for the thicknesses of the cross-pieces, these proportions will be seen from the drawing.

The first two of the cross-pieces are to be made of wood 1″ thick and 2″ broad; the lower of the two is to extend 15″ on each side of the upright, so that it must be 2′ 8″ long; whilst the second one is to extend 9″ on each side, and must therefore be 1′ 8″ long. The third one need only be 1″ × 1″ broad and 1″ thick. All of these are to be "let in" to the upright—that is, a piece of the latter is to be removed, in order to allow them to sink into it at the crossing. Thus a recess, 2″ high and 1″ deep, will be cut on the inner side of each of the uprights for the first two cross-pieces; and another, 1″ high and 1″ deep, for the third one. Looking from the outer side the uprights will project 1″ from the cross-pieces. The edges of the uprights, the upper edges of the bottom horizontal, and the lower edges of the other cross-pieces are to be chamfered off with the drawing-knife and spokeshave. Two mortises are to be cut through the uprights, and two through the lower horizontals. These are to be 2′ long and ½″ wide, and blocks are to be nailed or screwed under the horizontals to act as feet.

Four pieces—of say 5′ 8″ long and 2″ thick—are now to be prepared, and at each end of these a tenon, 4″ long and ½″ thick, to be cut—thus reducing the length to the pieces to 5′ 0″ from shoulder to shoulder; in each tenon, at precisely 2″ from the shoulder, a square hole ½″ square, but tapering very slightly towards the bottom, is to be cut.

It will be convenient in making up, to proceed as follows: Insert the uprights in their proper mortises and secure the tenons by means of screws, having previously nailed the blocks underneath. Next screw on the three cross-pieces, and finally raise the upright sides and unite them by the cross-rails just made, the tenons of which will pass through the mortises; and then square pins, about 3″ long, tapering

slightly towards their ends, are to be inserted into the holes previously made, and tightly driven in.

In order to give additional support to the shelves, curved struts may be added if the stand is to be a large one. These should, of course, be fixed before the cross-pieces are screwed on, as they must be mortised at their ends into the horizontal and the uprights. Care should be taken, in getting out these curved pieces, that they are so cut that as many as possible of the fibres of the wood run the whole length of the strut; for it will be readily understood that if they are cut the cross way of the wood, they will be liable to break directly any weight is brought to bear upon them. In order to accomplish this, it is advisable to cut the shape out of a piece of paper, which may be moved about on the wood until it is found to be placed to the greatest advantage, when the form should be traced around it with pencil. The shelves are to be made of 1″ wood, and should be 6″ wide.

Having placed these temporarily in their situations, and having marked on the horizontals the exact position they are to occupy, two holes should be bored with the ½″ bit, extending about an inch downwards; and into these pegs are to be glued, rising ¾″ upwards above the level of the cross-pieces; corresponding holes, ¾″ deep, are to be bored in the underneath surface of the shelves, which may then be dropped on the pegs, and so fitted in their places. The weight of the flower-pots will be quite sufficient to keep them in position.

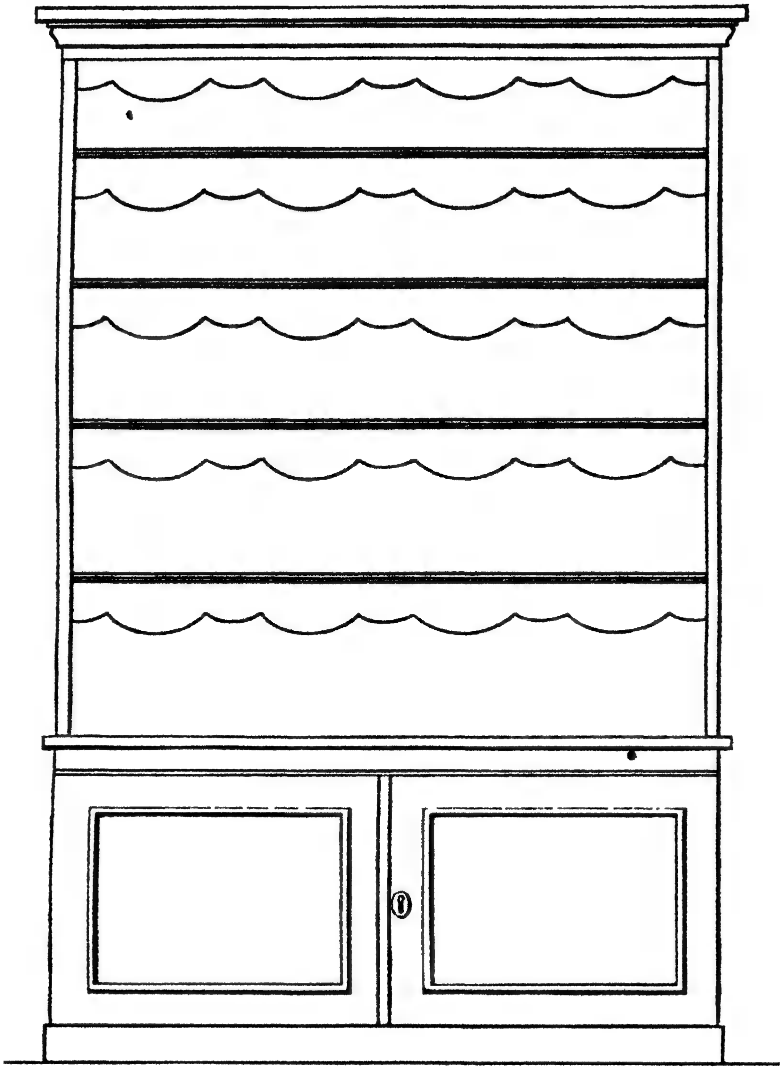
The upper tier consists of only one shelf, which will be fixed in a similar manner—excepting that the pegs in this case must be altogether smaller, so as to be suited to the smaller horizontals.

The top of each upright is to be surmounted by a flat, circular, square, or octagonal piece of board, on which a flower-pot may be placed, thus completing the whole.

It will be seen that a stand made according to these instructions may be taken to pieces by simply lifting off the shelves, withdrawing

the pins passing through the tenons of the pieces uniting the ends, which may thus be at once separated. The parts may then be put by for future use, or may be easily packed for removal.

The stand should be painted, but not green—the generally-adopted colour for flower-stands, by which the colour of the leaves of the plants is deteriorated in appearance. It may be made of "pitch pine," and will then only require varnishing; or it may be made of oak, which will only need oil-rubbing; or it may be made of simple pine, and may then be either stained oak, or grained, or painted a neutral grey, which will not interfere with the colours of either the leaves or flowers.



THE LIBRARY, STUDY, OR "MY ROOM."

(Fig. 38.)

TO BUILD A SET OF BOOK-SHELVES.

Some people call their *sanctum* by the one name, some by the other, but "a rose by any other name,"—we must not finish the sentence, for

the fact that we cut it down in its prime is the only novelty we can present in its quotation—used up as it is by every scribbler. For our own part, we prefer the simple term "My Room."

"Come into the garden, Maud," is a dear old song; the invitation, perhaps tendered selfishly, promises quiet conversation, and, as the result, happiness. But when one man calls on another (we prefer the term "man" to "gentleman:" it has more of a college sound about it), it would seem rather loud to say "Walk into the library," where we should expect to find miles of well-bound books standing primly on shelves and carefully ranged according to their sizes. "Study" is much better, but even that sounds shoppy, and implies that the room is devoted entirely to learned work; and your lady friends will call it your "studio," associating it with a Turkish dressing-gown, velvet slippers, and embroidered cap with a poetically long tassel: a sort of room where one has chemical apparatus, of which we do not even know the use—monsters on the table, in the very throes of anatomization in which they were when purchased second-hand by some student twenty years ago. This is all very well, and may look very well when one's mamma, having previously explained to visitors that "John is working so hard that I am afraid he won't see anybody," inserts her dear, good face through the narrowest possible opening of the door, asking, "*May I* come in?" You say, "Yes, of course;" and the dear loved one, having immolated herself as the thin edge of the wedge, adds, "And here's Mary Jones and ——." We don't hear the rest. We say, "Oh, of course; by all means!," the whole delightful bevy having already marched into the room in single file, each one exclaiming, "Oh, how lovely!" "Oh, Mr. John! how awfully clever you must be!" or, "Oh! I wanted to ask you——;" whilst another pretty proprietor of the prettiest bonnet in the world———Pardon! We were thinking of those remote periods of which it might be said, "There were bonnets on the earth in those days!" Now,—— But the subject of our article is not

what ladies wear, but carpentry for gentlemen. So let us keep to our subject.

The invitation, then, which means real, sound, sensible "talk," is comprehended in the words "Come into *my room.*" Then we know what to expect: objects meant for study, papers showing work, the odour—not lavender-water, but business—modified, or, as may be thought, intensified, by that of "the weed."

"Here pitch our tents," then, as said the Third Richard of blessed memory. It is a room devoted to sound study: there is a place for everything, but everything is not necessarily in its place; for if we are using a book, it cannot be expected to be standing at ease on the shelf; and if we are writing a paper, be it sermon or essay, or an article for one of the "Mags," we must throw each sheet as written on the floor. We clear up towards evening, and about once a week we are martyrs, and consent to be "thoroughly dusted," as our lady keepers tell us; but, excepting this, the room is our battle-field—our workshop—and the workshop must be dirty that the palace may be bright. So, although we do not tolerate dirt, we call our den "our room," in which we have order in a certain amount of disorder, and we have comfort.

We will, then, proceed to show how comfort, order, and convenience may be promoted by a little knowledge of carpentry. We propose, therefore, to give the method of making a series of book-shelves, with a cupboard, or, rather, a couple of cupboards, underneath—premising again that the measurements are merely proportional, to be altered or adapted according to circumstances.

The lower portion of this piece of furniture is a simple case made of wood 1″ thick. Its height is to be 2′ 4″, inclusive of the top; and therefore the two pieces forming the sides are to be 2′ 3″ high, and they are to be 1′ 7″ wide from back to front. The bottom is to be nailed between the two sides; and therefore, as the external breadth of the case is to be 4′ 6″, it will be 4′ 4″ long, whilst the top is to be 4′ 8″

long and 1′ 9″ broad. The top is to be nailed on in such a manner that it may be flush with the back of the case, projecting an inch on each side, and 2″ in the front; and immediately under this in the front a strip of wood, 1″ thick, 3″ wide, and 4′ 6″ long, is to be nailed.

At the bottom a strip 3″ wide, 4′ 6½″ long, and 1¼″ thick, is to be nailed, projecting ¼″ at each side—the ends being planed to an angle of 45°, and pieces of 3″ width and ¼″ thick, are to be mitred to this piece, so as to form a projecting plinth of 1¼″ in the front and ¼″ at the sides.

Inside this case one or two shelves may be placed—resting on ledges screwed to the sides, or the whole space may be divided into compartments to suit the wishes or necessities of the amateur; and the back, made of ½″ boards, is to be nailed or screwed to ledges on the inside of the top, bottom, and sides, so that it may be flush with the edges of these. Or the whole space may be first divided vertically by a wall in the middle, and ledges for shelves will then, of course, be required on each side of this.

The size of the doors will thus be 1′ 10″ high—that is, the whole height of the case—*minus* the width of the strips at top and bottom (3″ each), between which they are to be fixed, and they are to be 2′ 3″ wide—*i.e.*, exactly half of the breadth of the case—as they are to be fixed on by hinges, screwed to their inner surface and to the edges of the case, which will then be covered by them, as in the wardrobe already described.

The frames of the doors are to be made of wood, 1″ thick and 3″ wide, mortised and tenoned together at their angles, and grooved on their inner edges to receive the panels, which are to be thinned down at their edges, and allowed free play in the grooves, as already described. They will, of course, be much improved by being surrounded by a neat moulding. The left-hand door having been secured by bolts at top and bottom working into the strips between which the doors are

placed, the right-hand door is to be fastened by a lock placed in the middle of its height.

The top may be varnished or polished, or it may be covered with good American cloth, which will be found very serviceable for the purpose. A half-round moulding should be nailed to the edge of the right-hand door, projecting half its width and covering the meeting-line of the doors—thus effectually preventing the admission of dust.

It must be pointed out that it is desirable that the back edge of the top should touch the wall against which it is placed. Although, therefore, we have said that it is to be flush with the back of the case, it must be understood to mean that such should be the case when the wall is a perfectly flat surface; but if a wainscot runs round the bottom, the back edge of the top must project from the case to the same extent that the wainscot does from the wall.

We must now turn our attention to the upper portion of our piece of furniture, consisting of a series of book-shelves. The sides will, of course, be the first portions requiring consideration. They are to be made of wood, 1″ thick and 11″ wide, and they are to be 5′ 1″ high, which measurement will be made up as follows: first space 13″, shelf 1″; second space 12″, shelf 1″, third space 11″, shelf 1″; fourth space 10″, shelf 1″; fifth space 8″, cornice 3″.

These distances should now be marked across the boards, and lines ruled accordingly. Oak or birch ledges should then be screwed immediately under the lines at which the shelves are to be placed. These ledges should be about 10″ long, so that their ends may be ½″ from the back, and ½″ from the front edges of the sides, and on these the shelves are subsequently to be nailed; they should be exactly the breadth which equals the length of the ledges, so that they may stand back ½″ from the back and from the front edge. It is not usual to have backs to book-shelves, so that in the suggestion here given there will be at least the charm of novelty, and the amateur is advised by

all means to enclose his shelves with a back; it is just at their open edges that books require protecting from dust. Leave them without the old-fashioned glazed doors by all means,—they were always in the way, and when one wanted to snatch a book hastily down, just at that moment we hadn't the key by us; and besides, we are not making a book-*case*), but do not grudge the little trouble and small expense of a few boards nailed at the back.

It will be remembered that the ledges for the shelves were set back ½". Now prepare two pieces of wood 3" wide, ¾" thick, and 4' 5½" long, and fasten these across from side to side at top and bottom by the dovetail notch. The dovetails being ¾", and the notches in the sides being cut at ¼" from the outer edge, and 1¼" deep, these cross-pieces will then sink into the mortises so as to be ½" from the back—on a level, in fact, with the back ends of the ledges.

In front, a strip of ¾" wood 3" wide and 4' 6" long, is to be placed, 3" of the edge next the top being removed to the depth of ¾", so that the strip may be nailed on flush with the front edges of the side-pieces.

The top is now to be prepared and nailed in its place: it should be 4' 10" long and 13" wide, as it is to project 2" on each side and in the front. The provision in relation to the projection of the skirting must also be borne in mind, and, if necessary, the top must be made to over-hang the back as well.

The back itself is now to be made of ¼" boards, well planed at their edges, and nailed close together—the nails passing into the shelves and into the ledges at the top and bottom; a strip ¼" square is to be nailed or glued on at the edge where the outer boards meet the sides, and strips ¼" thick and 1" wide may be glued over the joints of the boards, in order the more effectually to exclude dust; in lieu of the latter, strips of thick paper may be used.

The shelves may receive additional support from upright pieces of

board placed up the middle of the width. These may be made to fit into a shallow groove on the top of each shelf, and be secured by a couple of nails driven from above into the support beneath, sprigs being driven in slantingly at their lower end just to keep them in their places; nails should also pass into them from the back.

This division is, however, injurious to the appearance of a nice long range of books, and the same end may be obtained in the following manner. Let a piece of wood 3″ wide and 1″ thick be fixed vertically to the top and bottom strip, a recess being cut in the back edge of each shelf to receive it; an iron bracket 6″ or 7″ long may be screwed to this under each shelf, which will thus receive all the necessary support.

Thus much for the structural portion of our work, and now let us proceed to its decoration. The woodwork—that is, if it be not made of oak itself—may be stained and varnished in the manner described further on. The shelves should then be covered with American cloth, of which about 4″ should be turned over the front edges so as to cover the tops of the books, the edges being cut out or "vandyked" to any pattern desired, or left in a sober straight line.

Some plain gilt moulding should now be obtained: it is sold in lengths of 8′ each, at *6d.* or *8d.* a length; it is about ¾″ wide and ¼″ thick. Its surface is dull gold, and its chamfered edge is burnished. This should be nailed on the edges of the shelves in front of the American cloth, and this will serve materially to brighten up the appearance of the whole piece of furniture. A smaller quantity of broader moulding of "ogee"-shaped gilt moulding should also be obtained, and run round closely under the top, which, it will be remembered, projects 2″ on the front and sides. This moulding should be 1″ thick, so as to leave a projection of 1″.

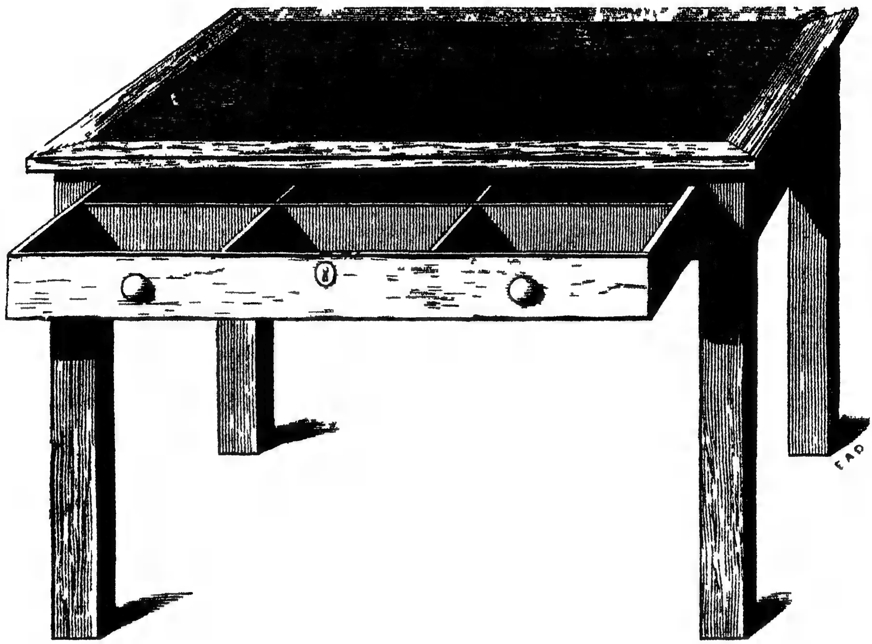
The shelves have been spoken of as fixtures, but some are made in such a manner that they may be shifted occasionally to accommodate books of various sizes. We do not think it is worth while bestowing

very much trouble on this consideration, because practically the necessity for moving the shelves is a matter of very rare occurrence, and the ledges might then be unscrewed, and their position altered.

There are, however, two methods adopted with which it will be well for the amateur to be made acquainted, so that he may be able to make his shelves moveable if he should desire to do so.

The first and simplest is to be cut with the saw a series of grooves of the thickness of the shelves up the inner sides or walls. When this method is adopted ledges are not required, as, of course, the shelves slide in the grooves. The trouble of cutting these grooves is often avoided by nailing on strips of about ¼″ thickness, leaving spaces between them equal to the thickness of the shelves ; these spaces then become the required grooves. It is needless to say that the jagged edges of the walls of the case caused by either of these systems do not improve the appearance of the object.

Another plan is to prepare four strips, 2″ wide and ½″ thick, and to cut in them indentations similar to the teeth of a large saw. These strips are then nailed on the inner edges of the sides, and into their jagged edges ledges are placed, and in these the shelves rest. The front edge of the strip may be rounded, and will then present the appearance of a bead.



A LIBRARY TABLE

(Fig 39)

We are now about asking our amateur carpenter to attempt a piece of work which will rather tax his skill, inasmuch as it will require great accuracy of work combined with strength The subject of his efforts is to be a Library Table—or perhaps we ought to have called it a table for "my room"

Every one who is at all in the habit of writing for any length of time will appreciate the advantage of a firm table, and we shall, in giving these instructions, indulge in the hope that much comfort and satisfaction will result from the combined efforts of the teacher and the taught

The wood we purpose using is good pine The legs will, of course, be the first to claim attention. They are to be made of wood 3′ square, and are to be 2′ 3″ long, and to this will subsequently be added the

thickness of the top, so that the absolute height of the table will be 2′ 4″. It is almost needless to say that this height may be varied to suit the wishes of the amateur, and to accord with the chair in which he is accustomed to sit.

The entire width across the front of the framing, for we are not at present taking the top into consideration, is to be 3′ 10″, and the width at the side is 2′ 10″.

The framing at the back and on the two sides is to be 6½″ broad and 1″ thick, and these are to be fixed to the legs by mortise and tenon joints. The tenons should extend across the whole width of the piece of framing excepting 1″ at the top. It should be ½″ thick, thus leaving a shoulder of ¼″ on each side. The mortises in the legs should begin at 1″ from the top and at ½″ from the outer sides of the legs, so that the framing, which has only a ¼″ shoulder, may stand back ¼″ from the side of the leg.

In cutting these mortises, and others frequently alluded to, place the leg horizontally on some block of wood or kitchen chair; sit on it, just leaving the part to be operated upon exposed; then holding the proper-sized mortising chisel rather slantingly, strike it with the mallet, so as to make a cut at about the middle of the space marked out for the mortise, subsequently returning the cut from the other direction—thus freeing a piece of the wood. Proceed in this way, gradually deepening and enlarging the cavity, and at each blow holding the chisel more and more upright until the end of the mortise is reached. The broad sides may afterwards be smoothened with the paring-chisel.

Great care should be taken that no chips or roughnesses are left in the mortises, as these prevent the accurate fitting of the tenon, and a bad joint is the result. The edges and corners of the end of the tenon must, however, be smoothened off, in case the angles of the mortises are not perfectly clear. When the framing is being put together, these tenons and mortises are to be brushed over with hot glue, and

the joint is subsequently to be strengthened by square tapering pins made of hard wood being driven in from the outer side, so as to pass through the tenons.

The inner angle of the top of the legs should be removed, and a cross-piece 1½" thick should be shaped and placed across, the screws being driven as shown in Fig. 40, *a* and *b*; holes are also to be bored at *c* and *d*, through which screws are to be driven upward into the top.

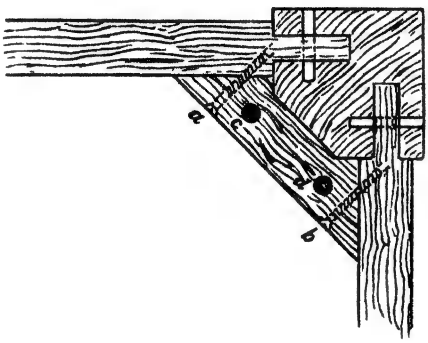


Fig. 40.

The framing for the front must, however, be made differently from that on the other sides, for it is to contain a drawer, for which space must be left, and for the support of which the necessary arrangements must be made.

This portion of the framing then must consist of two pieces of wood 1" thick and 3" wide, and these must be placed with their narrow edges forward: the lower one must have its under-side on a level with the lower edge of the framing on the other sides, and must be mortised into the legs by tenons, the whole thickness of the wood, but ½" narrower on the edges; the length from shoulder to shoulder is thus to be 3' 4", and each tenon is to be 2" broad and 1" thick, the mortise being, of course, cut across the width of the leg. In addition to being glued in its place, a screw should be driven through the leg from the

inside, so as to pass through the tenon. A 2½" screw will be required for this purpose.

The second piece is to be mortised into the tops of the two front legs by the dovetail tenon, as shown in Fig. 41, and is to be nailed or screwed down.

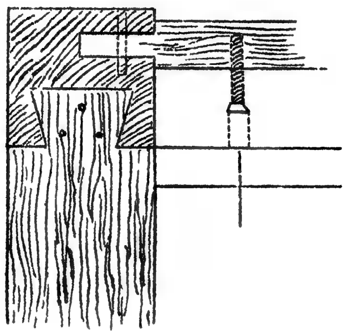


Fig. 41.

The front and back of the framing should be made up first, and these being completed, they are to be united by the side-pieces already described. It will, however, be clear that as at present arranged the drawer would not be sufficiently supported, for it would rest on the horizontal piece in the front only—the back end of the drawer would thus sag down, and would thus cause the drawer to grate in opening—ultimately wearing away the edge and the upper surface of the horizontal.

It becomes necessary, therefore, to provide strong ledges on which, in addition to that in the front, the drawer may run.

Fig. 42 shows the construction proposed. A is the top, B a section of the side-piece, which is supposed to be cut across, and C the ledge. This is to be made of a piece of good firm wood—oak or birch, 2½" wide and 2" thick. It will, of course, be understood that, although we speak of one piece, there will be a similar one required for the other

piece, and therefore the present operation may be carried on whilst the two pieces are set in one length. Out of the one edge of the wood a piece of 1″ deep and ¾″ broad is to be rebated, leaving a ledge or step 1″ thick and ¾″ wide.

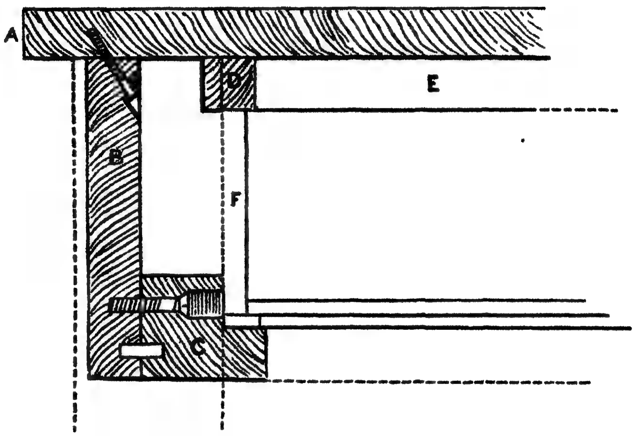


Fig 42

Now, it will be clear on referring to the diagram, in which the leg which has been removed is shown in dotted lines, that the leg projects beyond the framing ¼″. The thickness of the framing is 1″, together 1¼″, leaving the leg 1¾′ wide inside the framing. The piece of wood on which we have just been operating was 2½″, of which ¾″ has been rebated, leaving a thickness of 1¾″, equal to the inner portion of the leg, so that when this piece is fixed in its place on a level with the lower edge of the framing, the surface of the remaining ledge will be level with the front piece on which the drawer is to run, and the edge at right angles to this ledge will be in a line with the inner side of the leg.

If any difficulty should be experienced in obtaining wood of the required thickness, or in working the rebate, the piece may be made up by screwing the step or ledge on to the other part.

These two pieces should be strongly attached to the sides. In the first place, about three holes, about ¾″ deep and ½″ in diameter, should be made with the brace and bit in the side which is to be next to the side-piece of the framing, in which corresponding holes must be made. Beech, oak, or birch pins are then to be inserted, and the whole glued in its place. It must then be additionally strengthened by a couple of screws, driven from the inside. Before inserting these screws, holes should be made with the brace and bit to a depth of about half the thickness of the wood. In the centre of these apertures holes are then to be bored with the gimlet, and screws driven into them.

It is convenient in this place to mention that when the top has been put on (an operation to be described presently), a piece of wood, D, about 1″ wide and 1″ thick, should be attached to it precisely over the ledge on which the drawers are to run. These will correspond in height with the upper cross-piece, E, in the front, and against these the top edges of the sides of the drawer, F, will work. By this means the drawer will be kept horizontal during opening, whereas without these upper ledges it would have a tendency to sag downward in the front when widely open.

The measurements for the drawer are necessarily fixed: it will be 3′ 4″ wide and 4½″ deep externally, for it will be remembered that the depth of the framing at the back and two sides is 6½″, and of this depth 1″ is taken up in the front by the upper, and 1″ by the lower, horizontal, between which the drawer is to run.

The sides of the drawer (½″ thick) are to be joined to the back (¾″ thick) by the common dovetail, and to the front (1″ thick) by a lap dovetail.

The bottom of a drawer of this size will necessarily require some support, and should therefore be constructed in the following manner: The entire width should be divided into three equal parts by two

pieces crossing from front to back. These pieces should be ¾″ thick and 3″ wide. They are to be let into the bottom edge by the dovetail notch at the back, and in same way in the front, excepting that the joint is to be of the character of the lap dovetail, so that the ends may not be visible in the front; and as the front is to be made of wood 1″, the dovetails can be ¾″ at both ends of the cross-pieces.

The drawer, with these cross-pieces well screwed down, is now supposed to be lying bottom uppermost. A ledge ¾″ square is to be nailed inside the bottom edge of each of the sides, and also on the back and front in the spaces allowed by the cross-pieces. The drawer is then to be turned, and it will be seen that the space is crossed by, as it were, two joists, and is surrounded by a ledge. The bottom of the drawer is now to be glued up of boards ¼″ thick, and is now to be placed from the inside, to rest on the previously prepared supports, to which it is to be nailed. The inside of the drawer will thus present a clear flat surface, well adapted for keeping drawings, engravings, prints, &c.

If it should be desired to divide the drawers into compartments, as shown in the sketch, the two cross-pieces will not be necessary, as the upright pieces which divide the drawer from side to side will answer the same purpose. These should be made of ¾″ wood and be ¾″ narrower than the depth of the drawer, the top edges being flush with the top of the drawer, and they are to be secured by nails driven through the sides. To these and to a surrounding ledge, then, the bottom, made of ¼″ wood, is to be nailed. Grooves may be cut across these pieces for the reception of cross divisions, but this is not absolutely necessary, as the cross-pieces may be nailed to small ledges, fixed by sprigs against the inside of the back and front, and against the two main walls already fixed.

Brass "hang-down" or "flush" handles for the drawer will be found better than knobs, which, however, are generally employed.

We must now take out the drawer for a time, in order to give attention to the top.

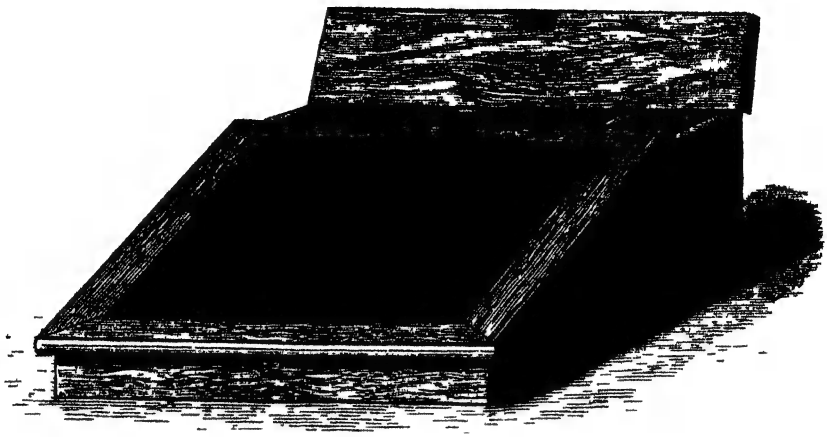
This is to be made of wood 1″ thick, carefully glued up. It may be either ploughed and tongued with the match-planes, or all the pieces to be joined may be ploughed with a groove, and a tongue of a harder wood inserted so as to enter into both parts. This tongue should be cut the cross way of the wood, so that the fibres stand at right angles to those of the boards they join.

The top is to project 1″ all round, and must, therefore, be 4′ × 3′. It is to be fastened to the frame first by means of glueing, and then by screws driven directly upward through the holes in the angle-pieces, shown at *c* and *d* in Fig. 40. In addition to these, screws are to be driven obliquely upwards from the frame, B, Fig. 42, in which apertures should be cut so as to allow of the head of the screw entering into the substance of the wood. This may be seen on looking at the underneath surface of any well-made table. If thought necessary, blocks may be glued in the vacant places along the edge of the frame where they touch the top.

The table may be finished according to taste. Thus it may be simply varnished without any staining at all, or it may be stained or grained. The top may be covered with American cloth tightly stretched over it, and nailed to the under-side of the projecting edge—in which case the corners and edges should be rounded off, thus materially retarding the wearing-out at those parts; or, assuming that the whole table has been grained to imitate oak, a border of oak veneer may be glued round the top, and French polished or oil-rubbed, and a piece of American cloth may then be put down within such border. In doing this paste will be found better than glue, as, owing to the fact that it does not set so quickly, it allows of the covering being better rubbed down and drawn out, and thus there is a greater chance of a good flat surface being obtained.

The legs have been spoken of as square pieces, but it is not at all necessary that they should remain so beyond the part into which the framing is to be inserted. They may be chamfered off at their corners or they may be turned—for if the amateur is not an adept in that beautiful art, he can readily get that portion of the work done out of the house—or, better still, they may be carved according to the taste or capabilities of the amateur.

Some hints on carving and the tools used will be given further on.



A WRITING-DESK.

(Fig 43)

This article of furniture is intended to be used together with the table designed for "my room." It has various advantages over the folding desk, and is by far the more commodious. The material used may be pine, varnished or veneered, mahogany, or oak: the latter will agree well with the table.

The general description of the desk is soon given. It is not to be a folding one, but the top is to be attached by hinges at its distant edge, and is to lock in the front. There is also to be a compartment at the top running the whole length of the desk, and also covered by a lid, which locks down to one of its walls, and there is to be a large secret drawer.

If the material adopted be pine, which is subsequently to be veneered, the neatness of the appearance will, of course, not be of much consequence, and therefore the common dovetail may be used; but if the wood is to be left in its natural condition, merely being varnished or otherwise polished, the joints must be very nicely done. In the present case, the lap dovetail joint is recommended for the angles. This

is very similar to the system shown in relation to the fronts of drawers, excepting that in this method the ends of the dovetails are shortened, and the recesses which are to receive them are not cut through. When joined together, therefore, only the ledge is visible on the return side.

The dimensions we give are for rather a large desk, but such a one is by far more comfortable to write at than smaller ones, and if the amateur prefers a smaller size, he is quite at liberty to alter the dimensions, or to vary them as he may think proper.

The length of the front is to be 18″, and of the side 21″. The rest of the measurements will be given as we proceed, and we will therefore set about our undertaking. Having cut the four pieces of the required length out of wood ½″ thick, give the proper shape to the sides They are to be 1½″ high in the front, and 5″ at the back; but it will be seen that the slant does not extend quite from front to back, but that there is a space of 4″ which will remain horizontal. The front and back having been cut, the whole of the pieces are to be dovetailed as above described, but are not yet to be permanently fixed together.

Around the inner side of the four pieces a groove is to be ploughed, which is to be ¼″ wide, ¼″ deep, and at ¼″ from the lower edges of the four sides. The bottom of the whole desk having been glued up of wood ½″ thick, ½″ longer and ½″ broader than the interior of the desk, is to be rebated by ¼″—thus leaving a step or ledge, ¼″ wide and ¼″ high, all round. This is to be inserted in the groove in the sides, the rebated surface downward. This should be done when three sides have been dovetailed together—viz., the back and two sides—and before the narrow side forming the front is attached.

Before putting the different parts together, too, a groove is to be ploughed on the inside of the back at 3″ from the bottom. This groove is to be ¼″ deep and ¼″ broad, and is to receive the rebate of a piece of wood ½″ thick and 3¾″ wide, including the projecting ledge left by the rebate, but it will be 3½″ when that sinks into the groove. This is

shown at A, Fig. 44, which represents a section of the whole desk. Recesses, ½" broad, ¼" deep, and 3½" long, are to be cut horizontally in the sides for the reception of the ends of this piece, which will thus be sufficiently secured to give support to an upright piece, B, which is ½" thick and 2" high, which may either be glued or united to it by a plough and tongue joint or by nails, as shown in the illustration. The

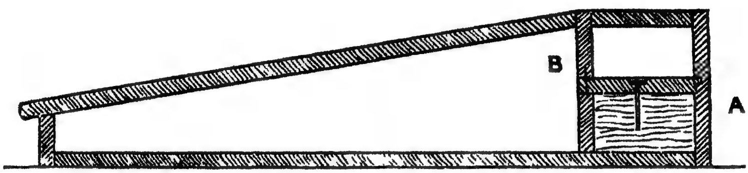


Fig. 44.

long compartment alluded to will thus be formed: it will be 3" wide and 2" deep. This may now be divided into any desired number of spaces to be used for various purposes.

In folding desks two of these spaces are assigned to ink-glasses; but as that plan is adopted to admit of ink being carried in the desk when moving about, it will not be necessary in the desk here described, which is intended to remain on the table. It is proposed, therefore, to form a square compartment at each end, and simply to divide the remaining portion into two by a central wall. The three pieces which are to form the divisions are to be made of ¼" stuff; they will be 1½" high, so as to admit of the lid being flush with the top, and 3" broad.

For a purpose to be presently explained, these pieces are not to be fixed, but are to be made to slide perpendicularly in grooves in the sides, which grooves are to be formed in the following manner: Plane up two pieces of wood exactly 20" long, 1½" broad, and ⅛" thick, and saw each of these accurately to the lengths of the compartments; so that if the pieces were placed against the walls of the compartment, they would correspond precisely with the marks made for the divisions.

Now plane the edges of the pieces to an angle of 45°, so that when glued in their places, they may leave a groove, as shown at C, Fig. 45, ¼" thick, and into this groove the dividing walls, the ends of which are to be correspondingly slanted, are to slide downwards, but are not to be glued.

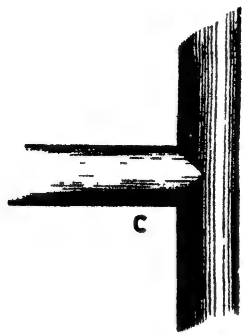


Fig. 45.

The lid of the whole is to be made to fit into the top of the compartment, so as to be flush with the top of the back and the wall in the front. It is to be attached by hinges placed vertically against the back, and it is also to have a small drawer-lock on its front edge, the bolt of which is to work into the front wall of the compartment.

Now, it will be evident that, as the whole height of the desk at the back is 5", and as the compartment which has thus far occupied our attention extends 2½" downward, there will be a space of the height of 2" vacant beneath it, and it is into this that the secret drawer is to fit. We say drawer, but of course the space may be divided so as to take two or more drawers, if desired; but that arrangement would involve a greater number of divisions in the compartment above (as will be seen presently), and, further, the breadth of the drawers would be reduced, as the wall we are now speaking of must not be divided, and would therefore have to be made as a separate piece in front of the drawers. This wall is to be made of ½" wood, and must be exactly 2" high, so as

to fit with the utmost accuracy into the space under the front wall of the compartment above; and as it is to have the appearance of being simply the back of the desk, and not in any way to show that there is a drawer behind it, the necessity of its remaining undivided will be evident.

It is, however, to form the front of a drawer the whole length and height of the recess. This drawer should be about $\frac{1}{16}''$ narrower, however, from front to back than the space into which it is to fit. It must also have dividing walls to correspond precisely with those in the compartment above; and this leads us to the method in which the drawer is to be secured, which must be as secret as the existence of the drawer.

Let us suppose that the drawer is finished and in its place. Mark on the floor of the upper compartment the exact position of the dividing walls by drawing a pencil-line on each side of them; next take out these walls, which, it will be remembered, are not glued in, and between the two lines marking the thickness of the dividing walls bore holes, which must be strictly perpendicular, into the dividing walls in the drawer beneath which are immediately under those in the upper compartment, and into each of these a very large brass pin, called a shawl-pin, or a large straight wire nail, or a pin specially made of thick wire, is to be dropped; and these, it will be clear, will perfectly secure the drawer against being drawn open, even if its presence should be ascertained; and, as the walls in the upper compartment, when restored to their places, will cover the heads of the pins, the means of security will also be hidden. A recess must be cut out with the small gouge in the bottom edge of each of the walls, to admit the head of the pin, which would otherwise prevent the wall sinking down into its place.

Of course, neither handles nor knobs of any sort can be allowed on the front of the secret drawer, and a difficulty will occur as to the way

of opening it. This is to be overcome in the following manner: Let D, Fig. 46, represent the inner surface of the back wall. Obtain two pieces of watch-spring, each about 1½" long, and having a hole at one end. Screw this end into a shallow recess in the back, leaving the other end free. When the drawer is kept in its place by the pins, the spring will be in a state of compression in the space of $\frac{1}{16}$", which, it will be remembered, has been left; but when the pins are withdrawn, the spring will exert its force, and the drawer will be forced forward. The upper

Fig. 46.

Fig. 47.

end of the spring should be bent slightly forward, which may easily be done with the round-nosed pliers, the steel having been previously heated at that part by holding it in the gas for a moment or two.

The lid or writing surface of the desk is now to be made. It is to be fastened by means of hinges to the front wall of the compartment at the back of the desk, and is to project an inch on each side and in the front. It will, of course, be glued up of different widths, and is to be clamped at its edges. Clamping is performed by the plough and tongue process already described, and will be clearly understood from Fig. 47, which represents the one edge of a clamped board. When boards are to be clamped in this way, great care must be taken that

both pieces are thoroughly dry, in order that shrinkage may as far as possible be prevented. It will be clear that in the case of the lid of the desk the contraction of the fibres will be parallel to the front, whilst in the cross-pieces it would be from left to right, as the shrinkage is caused by the fibres becoming closer together during the process of drying. The result of such contraction would be that the ends of the cross-pieces would protrude beyond the line of the front, and would subsequently require planing down.

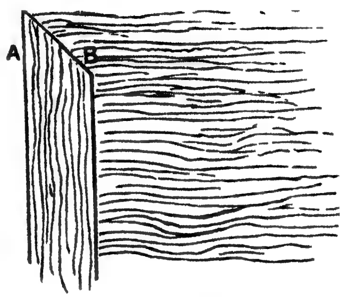


Fig. 48.

Another method well adapted for our present purpose is that called "Mitre Clamping," shown in Fig. 48. In this system the cross-piece, A, is cut off at an angle, the other board being cut to the same form, at B, in order to receive it. If both parts are well seasoned, this is an exceedingly neat method, well adapted for the present purpose; but if the wood is not thoroughly dry, the cross-piece will separate from the other, a crevice will be formed, and the stability and appearance will be materially injured.

It must, in fact, be established as an axiom that, unless wood is properly seasoned, the very best methods of joining must fail, whereas boards when once thoroughly dry require only sufficient clamping to prevent warping through change of temperature.

The desk-lock differs from that used for drawers or cupboards in

having a second part, or "hasp," which is fixed to the lid. The lock must be put on first, and when that has been done the hasp is to be placed in it, and the key turned. The lid is then to be brought down, when the sharp points, which are usually bent up at the angles of the plate to which the loops are attached, will make indentations in the lid—indicating its exact place. The shape of the plate is then to be cut out, so that it may sink into the wood, and it is then to be screwed on. If there are no projecting points on the plate, the back may be rubbed with a little of the blackened oil from the oilstone, when an impression will be made on the lid which will serve the purpose.

It is very desirable that persons who are much engaged in writing should vary their position by standing during some portion of the time whilst still pursuing their employment. This desk may, therefore, be moved on to a high stand for this purpose.

It will scarcely be necessary to give any instructions for making such a stand, as it is simply a high table, which may be fitted with a drawer, and may also have a leaf or slab on each side, so that its surface may be extended if required. These flaps should be attached to the top by means of hinges, and should have a bracket under them, made of a piece of board, which should move on hinges screwed to the framing of the stand. A ledge will be required on each side to connect the legs at about 1′ from the ground, and these are to be united by a cross-piece in the middle—the joint used being the mortise and tenon. Or a stand may be made somewhat in the form of a stool, which may be placed on the table to raise the desk, in order to afford occasional change of position.

A strip of wood about 12″ long should be screwed by one of its ends to the inner surface of one of the sides of the desk, and a few steps should be cut in the lid, so that when the slip is raised it may catch in one of the steps, and thus support the lid when the desk is kept open for awhile.

A HOUSE LADDER AND LIBRARY STEP.

(Fig. 49.)

The first an exceedingly simple article, but one of great use in a house. It should be very light, but strong, and should, if used for general house purposes, be hung up in some convenient part of the house, where, although out of the way, it may always be accessible. It should, for house use, be made of pine; but it may also be made in mahogany or oak, to be used in the library, but as these woods are heavier, the sides and steps must be of smaller dimensions than those here given, which are intended for pine.

The wood should be 1″ thick and 3″ wide, and should be well planed on all sides. The front edges may be finished off by a narrow border, made by running the beading-plane down the angles. The length of the sides may be 7′ 0″ or 8′ 0′, according to the heights generally required to be reached, and when this length has been decided on, one of the pieces should be held against the wall at a slant deemed sufficient, and the bottom marked with the pencil, so that a horizontal line for the ladder to rest on may be obtained. When this has been done, the extreme angle in the front should be cut off, so that no pressure may rest on it, by which the wood in the front might be split off.

The first step should be at, say, 1′ 0″ from the bottom, the rest should be about 10″ apart. Having marked the places for the steps, lines are to be drawn across parallel with the bottom end; this may be done by means of the bevel, which having been set to the proper angle, will ensure the steps being parallel with each other.

These lines are now to be sawn to the depth of ¼″, and the wood between them is to be removed, the back of the chisel being used for this purpose. The ladder at the first step should be 11″ broad, and at its highest step it should be 9″ inside measure. Cut the first and the last step, therefore, to 13″ and 11″. Now, in addition to the grooves

in which the steps are to fit, cut oblong holes quite through the wood in the grooves belonging to the bottom, top, and middle steps, and cut tenons ¾″ long in the steps themselves, so that they may reach to the outer sides of the ladder. Insert the first and last steps in their places, and the exact lengths of the middle and other steps may be measured, as well as the exact slant of their ends, caused by the widening out of the sides towards the bottom.

The steps should be made of wood about ¾″ wider than the sides, which projecting edge should be rounded off in the front, the ends of it being cut off slantingly. Before the steps are inserted in their places, the tenons should have two slits made in them with the saw; into these, when the ladder is put together, wedges of hard wood should be driven.

These three steps should be inserted first, and having been thoroughly well secured by being wedged up, the rest are then to be forced into their grooves, and are to be secured by nails driven in from the sides.

The upper end must now be cut, so that it may be parallel to the wall against which the ladder is to lean, and a recess of about ¾″ should be made to receive a piece of wood, about 4″ broad, to be nailed across the top. This piece may be loosely covered with American cloth, or leather if for library use, some hay being forced underneath it, so as to form a kind of cushion, which will prevent the top of the ladder injuring the backs of books, or otherwise damaging a wall.

The amateur may now apply the knowledge he has obtained in the construction of a Library Step.

This will, as a rule, be made of bay-wood, mahogany, or oak, and consists in the first place of two short ladders, made precisely in the same manner as the last. Three steps will, generally, be found sufficient, but such points must, as often stated, be left to the wishes of the constructor.

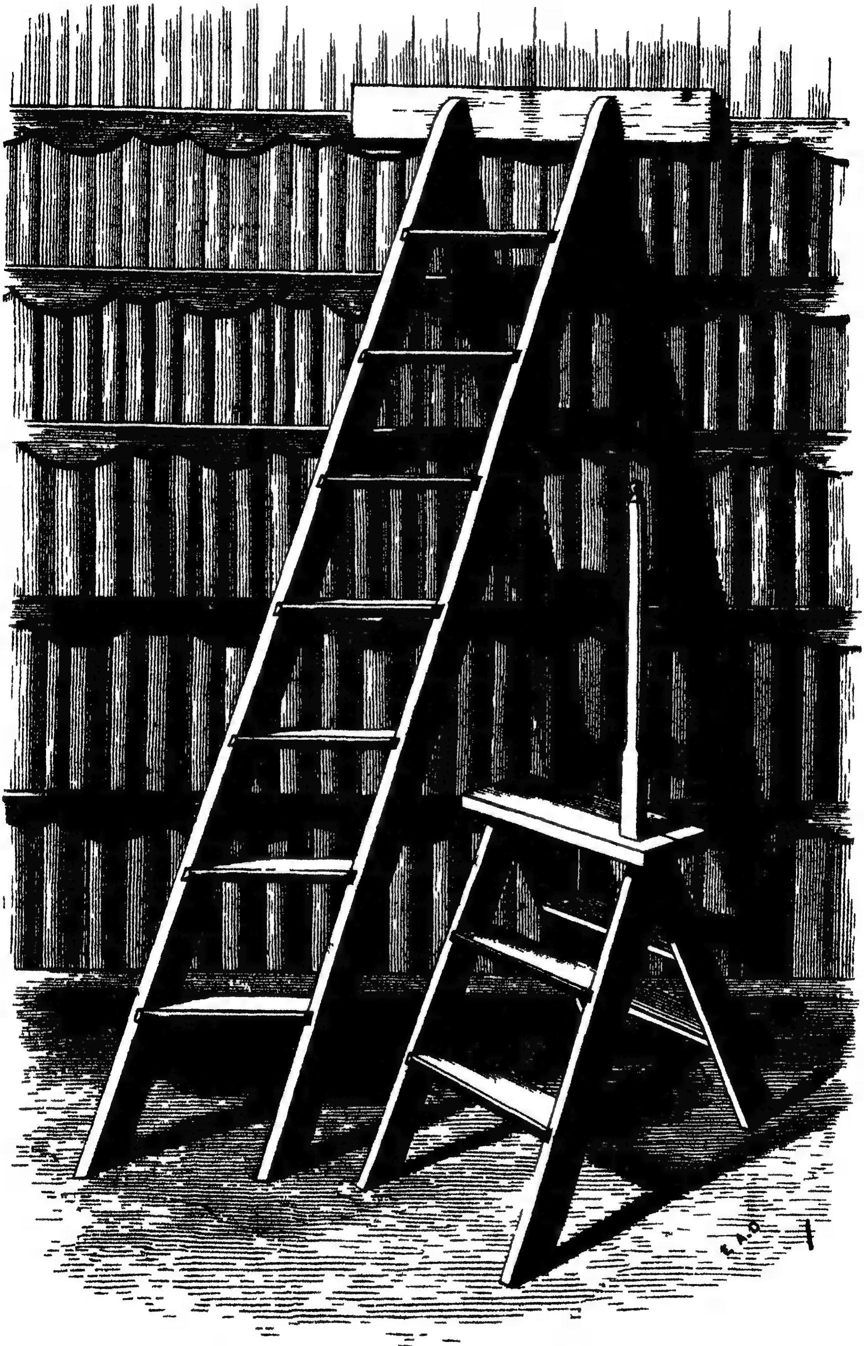


Fig 49 – A HOUSE LADDER AND LIBRARY STEP

The height of the steps may be 12″ for the first and 10″ for the others, making a total length of 3′ 6″. The real vertical height will, of course, be rather less than this, as the perpendicular dropped from the apex of a triangle is shorter than the sides.

Having marked the exact positions of the steps, the inner ends of the sides must be cut slantingly, at such an angle that, when the ladder is made up, the steps may be horizontal when the two ends, or rather the slanting parts of them, touch each other; and the extreme end must be cut at a right angle to this slanting line.

On these ends pieces of board are to be nailed, so that when the ladder is used, they may meet and form a wide surface at the top, on which the several books taken from the shelves may be placed. These boards may either be nailed on, or tenons may be cut in the ends, to pass through mortises in the boards. The hinges are then to be screwed on. These may be obtained of different sizes, and may be fixed either inside or outside. Should the former plan be adopted, it will be necessary to put them on before the steps are fixed in their places.

The upright hand-rail should be made of wood 1½″ square. It is to pass through an aperture cut in the top, and is to be screwed to the inner side of the ladder. The upper portion must be chamfered at its angles, or it may be rounded with the shaping-knife or spoke-shave; or it will of course present a much prettier appearance if nicely turned.

In a ladder of the size here described, it will not be necessary to connect the legs at the bottom of the sides; but if larger dimensions be adopted, a hook or cord will be required. If the room in which the ladder is to be used is absolutely the library, and is of a large size, there will be no necessity to make the ladder to close up, and therefore cross-pieces may be mortised into the legs, so that each side will form a letter A; but of course the piece of furniture will not in that shape be so portable as it would otherwise be, and this diminishes

its use in a house where such a small ladder is often called into requisition in lighting gas, reaching upper compartments of cupboards, &c.

Small castors may be affixed to the feet, and will be found very convenient when books are required from different parts of the shelves. It will, of course, be understood that there is no real necessity for steps on each side, but it is not much more trouble to make them than it would be to make a backstay, as in a common step-ladder, whilst it would spread the use of the ladder over a greater area; for instead of coming down to move it when the book required is found to be farther on the shelf than can be reached at the moment, the top can be crossed, and the other side reached without difficulty, and the desired book obtained without loss of time and with very little more trouble.

A GARDEN SWING.

(Fig. 50.)

We now proceed to show the method of constructing several out-of-door works, and, as these will involve more practical knowledge than has yet been called into requisition, and as the labour may be materially lightened by the application of certain principles, we feel that no apology will be necessary for introducing such technical instruction as may be useful to the amateur.

"Home made" is a very nice, kind, and domesticated term, and when we hear our friends say of something we have made, "You know it is only the work of an amateur," we think them exceedingly charitable, but cannot help feeling that their praise is very nearly allied to pity, and that it really means—"Poor fellow! he couldn't do better."

Now, the whole of this is a mistake. The work of a gentleman may not perhaps be as well executed as that of a carpenter who has during his whole life done nothing else but saw wood and put it together, and whose success is the result of manual practice—not (owing to his defective education) of knowledge; but, as far as scientific construction and application of principles are concerned, the education of the gentleman ought to enable him to outstrip the artizan, whose aid he may, in the heavier or more manipulative portions of his work, do well to call in.

Let us think of our feelings if, after a croquêt party, our fair friends adjourn into the arbour to rest or have a "kettledrum," a heavy shower comes on, and we discover that the ladies, owing to the faulty construction of the roof, are not much better off than if they had been on the lawn. They are submitting with the best possible grace, when one of our kind "friends" (save us from them!) mildly reminds the martyrs —"You know, this is only John's building; and one can't expect it to be as good as a proper carpenter would have built."

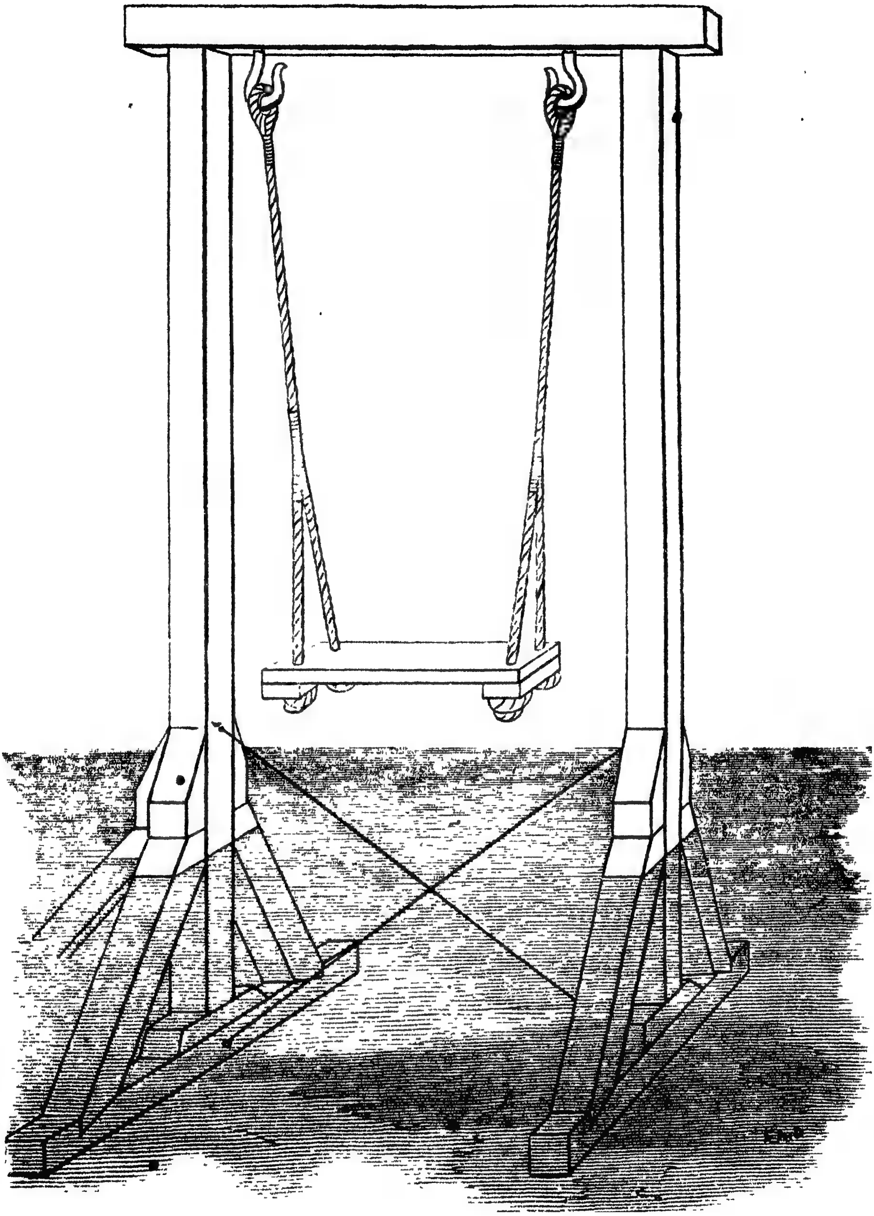


Fig. 50.—A GARDEN SWING.

In giving directions for putting up a Garden Swing, therefore, we shall take the opportunity of imparting some little instruction in relation to the general principles of foundations, and works in wood in general,

which the gentleman house carpenter will be able to apply in other cases.

The general method of constructing a swing is to insert the ends of two posts into the ground ; to attach these at the top by means of a horizontal to which the ropes are hooked. We have, in fact, seen swings in which this last member has been absent—the result being that the weight on the swing has had the effect of drawing the posts towards each other at the top.

But let us explain why the method above alluded to, is wrong.

In the first place, the whole weight of the swing and its occupants is borne by the single spots of ground on which the uprights rest ; and as these are pointed at the bottom, their sinking is facilitated. If they were to sink gradually and perpendicularly, it would not in the present case be of very much consequence, as the uprights are not like piles, supporting a structure of brick and stone, which would be sadly injured by such sinking ; but, as the swing acts in a manner tending to sway the posts in alternate directions, they naturally become loosened—an aperture is created around their feet, into which the water flows at every shower of rain.

Now, if this aperture were kept always full of water, the injury to the wood would not be so great as is caused by the circumstance that the moisture sinks—by which means the lower portion of the post is kept always damp, whilst that near the surface is alternately wet and dry. The post is, therefore, divided into three portions: one underground and always damp ; another above-ground and always dry ; and a third which is neither above nor below-ground, which is not kept always wet nor always dry, but which gets a soaking and then dries gradually.

Every one who has been accustomed to river-sides must have noticed the strange appearance of the piles to which barges, &c., are moored. They are perfectly square and sound at their upper part, and the same

below the water, but at the part immediately above the surface of the stream they are narrow and rotted away; and this portion represents precisely the difference between low and high water, the part of the pile which is alternately wet and dry.

Now, it will be evident that this part of the upright of the swing is precisely at the ground-line, and that at the point where the most strength is required; for the stress being quite at the top, the whole post becomes a lever, the point at which it enters the ground being the fulcrum, and thus the liability to break off at this point is of course great. We remember hearing of a case where this occurred. The village carpenter had put up the swing; it broke in the manner described, injuring the child who had been swinging, another who stood close by, and doing other less serious damage.

It is clear, then, that the area of the foundation must be spread, and our meaning will be understood by the few simple lines in the annexed diagram.

Let A, Fig. 51, represent the surface of the ground, and B the lower end of the post. Now, it will be evident that if a beam of timber be placed under this point, the weight will not fall on B alone, but will be distributed over the whole area covered by C D, and that the struts E and F not only carry support higher than the ground-line—viz., to G—but, by preventing the swaying of the post, avoid the occurrence of the chasm around the foot which has been alluded to.

We now proceed to apply this principle. Prepare two pieces of sound wood—larch is, perhaps, the best—of 4″ square and 6′ 0″ long. These are to act as the sleepers on which the whole structure is to rest.

Now, the general method of attaching the upright to this would be by mortising; but it must be pointed out that whenever any part is taken out of the length of the fibres of wood, the whole plank is proportionately weakened; thus,

Let us suppose A B C D, Fig. 52, to be a mortise cut in a piece of

timber. It will be clear that the connection between the ends of the fibres in the rectangles E A C F and B G H D is completely severed by the cuts at A C and B D, and that the whole strength of the wood now remains in the rectangular sections contained in E I J G and F H L K, the only connection between the sides being by the lateral adhesion of the fibres contained between E G H F.

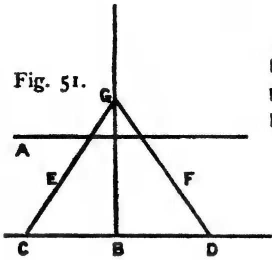
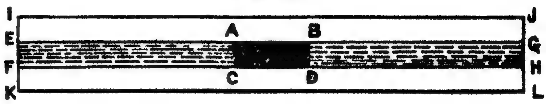


Fig. 51.

Fig. 52.



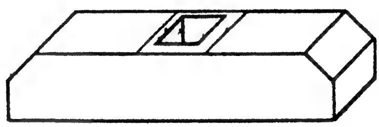


Fig. 53.

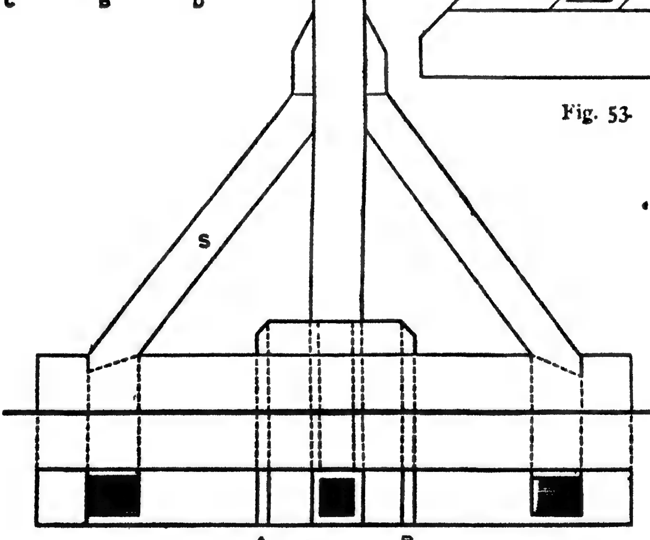


Fig. 54.

It is, however, clear that it would be absurd to weaken the sleeper at precisely the point at which the greatest strength is required, and therefore, instead of cutting a mortise in the middle, the better plan is to build around the spot on which the post is to rest, a mound or wall, which shall give the required support without diminishing the strength of the sleeper. This is done in the following manner (Fig. 53):

Having prepared a piece of timber, 4″ broad, 3″ thick, and 20″ long, saw off the ends at any angle, and cut a mortise through it, 2″ long and 2″ broad. Screw or nail this down at the required part of the sleeper, as shown at A B, Fig. 54.

The post, made of timber 4″ thick, the end being reduced to a tenon 2″ square, is then to be inserted in this mortise. There will be no force exerted which could tend to draw the upright out of this mortise, and a single screw driven in on each side will be all that is required, as it will be otherwise secured.

The slanting pieces, shown in Fig. 54, are called struts (S). They are to be made of wood 4″ thick. They must be cut slantingly at their ends, so as to agree with the direction of the surfaces of the upright and horizontal to which they are to be united, their extremities being cut off at right angles to this slanting line. At their lower ends they may be mortised into the sleeper, as the mortise will occur at a part where it will not materially weaken the wood; but it will be clear that the upright must be kept intact, and that no cutting away of any portion of the fibre is admissible.

A stop-block is, therefore, to be screwed on each side, and against this the squared end of the strut is to abut.

The posts are to be connected at their upper ends by a cross-piece, into which they are to be tenoned, an iron bolt passing through them, and being secured by a screw-nut.

There will be little if any tendency to sway to the right or left side; but, as the whole swing is constantly being shaken, it is desirable to guard against the danger of such occurrence. This may be done in two ways: 1. By iron rods, attached to screw loops in the sleepers, and in the uprights at a few inches above the ground-line, each rod to pass from the sleeper on the one side to the post on the other. These rods may be simply made of rod-iron, bent into loops at their ends, an operation which any blacksmith can accomplish, or they may be pur-

chased with screw cylinders in the middle, by which they may be tightened up. 2. A stop-block may be screwed on the outer side of each upright, against which struts may be placed, their lower ends abutting against square props driven into the ground.

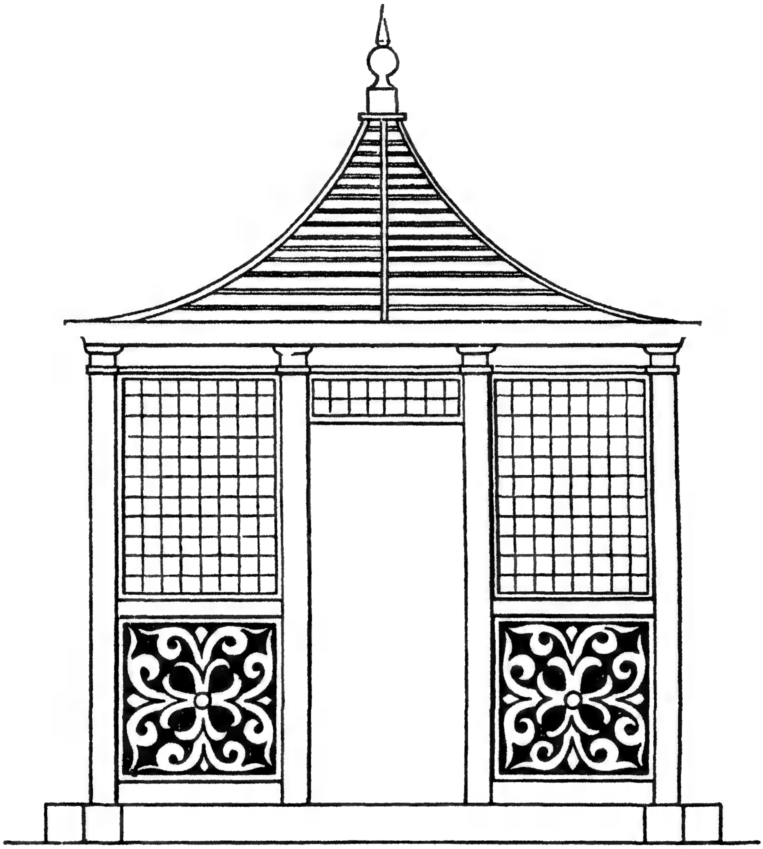
The hooks by which the swing itself is attached should not be simply screwed into the under-side of the cross-piece at the top—in which case the whole weight of the swing and the occupant would be borne by the fibres of the wood surrounding the thread of the screw. An iron plate about 6″ square, properly drilled, should be placed over the respective apertures, and through these the ends of the hooks should pass, being secured by screw-nuts.

The swings may be purchased ready made, or may be formed of good strong rope, the loops being composed of iron rings, around which the rope is tightly bound.

As already stated, it is not presumed that either of the plans for preventing swaying to right and left may be necessary, as the sides of the trenches dug in the ground to receive the foundations of the uprights will in most cases be sufficient protection. These trenches must vary in depth according to the quality of the ground: but it is, of course, understood that the woodwork here described should be sunk at least half the height of the slanting struts. The lower parts of this structure should be well tarred.

Very little reflection will, however, show that a swing may be constructed on precisely similar principles to stand above-ground, and may be so made that it can be taken down and housed during the winter months. The sleepers in that case will require to be longer, so as to preclude all chance of the structure overturning; and the cross-rods between the posts must be dispensed with, as they would be in the way.

The whole of this framework should receive about four coats of paint—two of which should be repeated each year.



A PAVILION OR ARBOUR.
(Fig. 55.)

A Pavilion or Summer-House, although not indispensable in a garden, is a very pleasant adjunct, in the construction of which the amateur may be employed not only with benefit to others, but to himself, the main portion of the work being carried on entirely in the open air. There are, however, ornamental parts, in which the ladies of the family may well lend their aid: viz., the sawing out of the ornamental patterns in the panels, by which they will acquire the use of the turning-saw and the keyhole-saw, and thus prepare themselves for that elegant and fashionable accomplishment—fret-sawing. The

great difficulty in that art is the power of turning the saw about so as to cut small curves in fine and close patterns. Here, however, the curves are large and the pattern open, so that the knack of managing the saw may be gradually acquired.

The pavilion which is to occupy the attention of the amateur is to be a permanent structure, and therefore it is not to be dependent upon posts, which, being driven into the ground, are liable to sink more or less, thus causing all the joints to be strained, and the whole building to be thrown out of square.

The entire structure is to rest on a timber framework—an "Oxford frame" in fact. The wood of which this is to be made should be 6″ square, and as the general external dimensions of the arbour are to be 8′ 0″ × 8′ 0″, the sides of the frame must be 1′ 0″ longer, so that they may cross each other, leaving a surplus of 6′ at each end (Fig. 56).

The method by which these four pieces are to cross each other is called "halving." The width of each piece having been marked on the other, both are to be sawn half-way through the thickness; the wood between the saw-cuts being removed, the pieces, when united, will present a level or "flush" surface.

There are, of course, to be four principal uprights, and these are to be situated at the corners; they are to be 4″ square and 6′ high in the clear: that is, besides the tenons at top and bottom, which are to be 6″ each (making the total length of the wood 7′ 0″), the tenons are to be 3″ square, half an inch of the thickness of the wood being removed on each side. The lower tenons are to be inserted in mortises at the angles (3″ square) cut through both pieces of the framing, which they will thus serve to unite. Between each pair of uprights two others, precisely similar to them, are to be placed, and all these are to be fixed by means of their upper tenons into a frame precisely similar to that on which they rest, excepting that it is to be made of wood 6″ broad and 3″ thick, whilst that of the lower frame is 6″ square.

Before these uprights are permanently fixed, mortises should be cut in the sides which face each other, and into these, the tenons of the cross-pieces dividing the lower from the upper portion of the structure are to be inserted. These cross-pieces should be made of wood 3″ × 2″.

Having described the general structure thus far, we will retrace our steps, in order to give some practical details as to manipulation.

The first operation is to plan out the ground. We suggest that, although it may be convenient to place the pavilion near a wall or in a corner, the brick walls should not form its sides, but that the structure should be independent of them. We are, of course, aware that in the small pieces of ground attached to some houses a nice shady nook is often found, affording two or even three walls, in the latter case requiring merely a front and roof. We do not, of course, say, "Reject such advantages"—and it will be found that the general principles laid down in these pages will enable the amateur to "run up" a nice little summer-house under these circumstances—but we merely say that if there be a choice of position, it is very desirable that the arbour here sketched should stand free from any wall.

The ground, then, having been marked out, a trench must be dug, in which the foundation frame is to rest. This trench is to be just 6″ wide, and not more than 3″ deep, and it must be *perfectly level.*

If the amateur house carpenter should think this portion of the work just a step beyond his speciality, and that he would in doing it be encroaching on the business of the excavator or navvy, we are sure his gardener, or any other man accustomed to wield the pick and spade, will soon accomplish it for him. In order to be guided in levelling the trench, a spirit level should be used; but if such an instrument is not at hand, the amateur must even be content to use water instead of spirit, and may make for himself a very fair substitute of an eau-de-Cologne, or other rather long and straight bottle, very nearly, but not quite, filled with water and corked. When this is laid down

parallel to the sides of the trench, the vacant spot in the bottle will indicate the highest point; but if the ground be quite level, the vacancy will be equally distributed.

The foundation framing should next be laid in its place, and as the trench is only 3″ deep, the top of the timber will be 3″ above-ground. This is necessary for the main portion of the building, in order to secure the floor as much as possible from damp; but the projecting ends of the frame beyond the crossing-point must be slanted downwards from the angle, so that the feet of persons passing around the arbour may not be caught by them. Or, if they are not thus rendered harmless and almost invisible, they may be made useful and visible by placing flower-pots on them, with climbing plants to run up the columns.

The four angle posts and the eight intermediate ones having been cut and tenoned, and the necessary mortises having been cut in them, the upper framing is to be prepared; and all these having been duly placed, we can again take up the thread of our description.

We intend again giving the constructor of the pavilion his choice—whether he will have a gravelled floor or a wooden one; but we are sure that if he consults the ladies, for whose especial pleasure he is in this matter employing himself, they will say, "Oh, a boarded floor by all means." In this delightfully free country it is only right that every one should have his liberty of choice, especially where he has to do the work and pay all expenses, and we will, therefore, describe the method of carrying out both plans.

One great annoyance of ground which has been a part of the garden, is the tendency to sinking, which must be remedied. But this is not all: the natural fruitfulness of the earth will not be restrained, and however much we may lay down gravel, one barrow-full after another, tufts of grass will keep on cropping up, until at last we feel inclined to invite the professional attendance of the sheep, to

clear the floor of our summer-house. To attempt to curb this would be waste of time: the cause must be removed, and therefore a foot or more of the earth must be dug out; brickbats, old mortar, broken bottles, fragments of flower-pots and crockery must be rammed down until a good, solid base is obtained, and on this, gravel is to be well beaten down. But this must be watched, and the process repeated should the ground exhibit any tendency to damp.

Now, the process here described costs both trouble and money, and we feel therefore quite justified, in recommending a boarded floor in preference, because—1. The trouble and expense of constructing it is not much more; 2. Because the work, if properly done, will not require any attention or repairs for some years; 3. Because it is infinitely less liable to strike damp to the feet, and is altogether more cleanly and pleasant.

It has already been said that the foundation frame is to stand 3″ above the level of the ground, and that the external size of the frame will be 6′ 0″. The internal space will then be 5′, that is, 6″ (the width of the wood of the framing) smaller on every side. Cut two pieces of wood 5′ 0″ long and 3″ square, and lay them down at equal distances parallel to the front within the area left by the square.

Now prepare six pieces of timber 5′ 6″ long and 4″ × 3″ thick, and place them on their narrow edge at equal distances inside the pavilion, running in the direction from front to back. These will rest on the framing at each end, and will be further supported by the sleepers previously placed, and will thus become the floor-joists.

It will, of course, be understood that these floor timbers are not to be planed. They are essentially the work of the carpenter; and now for that of the joiner.

Floor boards are laid down in various ways: the simple "folded floor" will answer our present purpose. The boards are planed so as to be absolutely true at their edges. Now let a few of the boards be

nailed down at such distances as to admit of a certain number of others being placed between them, but which can only be inserted by force, as the breadth of the opening must be such as barely to admit of the aggregate width of the boards, in order that the joints may be absolutely close when all are brought down to their places. The intermediate boards are then to be laid down, and it will be found that the last will not fall into its place; therefore, raise the next one and place the two edge to edge, to form a sort of triangular arch. Place a plank across the apex of this, and by stamping on it, both will be forced into their places, when they may be nailed down.*

The roof must now claim attention. It is to be supported, in the first place, on four angle-ribs, abutting against the tenons of the corner posts, and a central block, which forms a kind of keystone.

The ribs should be cut out of wood the fibres of which are as straight as possible, and some of them running along the whole length, as at A and B, Fig. 57.

These ribs must be cut out of boards 6″ wide and 2″ thick, and the curve should be such as to leave them quite 3″ wide at the narrowest part. The lower end must be cut off square, so as to abut safely against the corner post, the angle of which must be squared off for its reception; and in the central block the angle must be removed up to a certain height, leaving a shoulder caused by a cross-cut, and against this the upper end of the rib will press, being secured by nails. An intermediate rib will be required on each side; this, which will be rather shorter than the angle-ribs, will fit into a groove in the central piece, and will abut against a block nailed on the upper horizontal frame.

These four ribs must be chamfered off on their curved edge, so that

* For detailed information in relation to floors and other branches of practical carpentry, the reader is referred to "Building Construction and Drawing for Carpenters and Joiners," by Ellis A. Davidson.

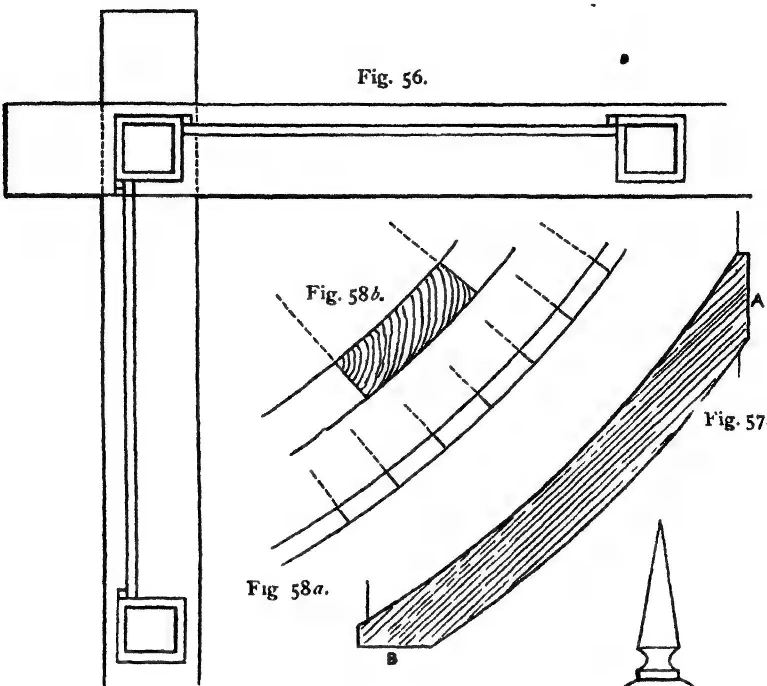


Fig. 56.

Fig. 58*b*.

Fig. 57.

Fig 58*a*.

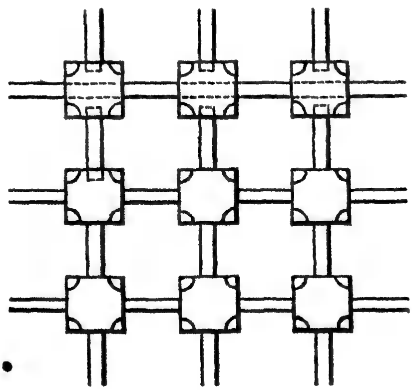


Fig. 60.

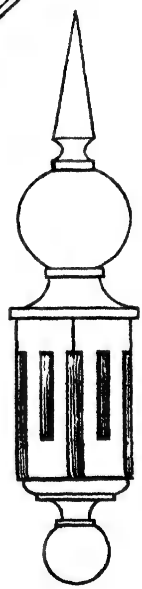


Fig. 59.

a sharp angle may be presented by the meeting of the two edges, to which the boards of the sides of the roof are to be nailed.

In the event of larger dimensions than those given being adopted,

more intermediate ribs will be required, and the angle ribs will require connecting by diagonal tie-rods.

Above the upper frame a cornice is now to be formed of four pieces of board, about 4″ wide, slanting outward. On this a curved moulding may be nailed, by which the appearance will be very much improved.

Before the roof is covered in, a piece of sheet zinc should be placed against the back of this cornice; and, resting on the upper surface of the framing, should be turned up against the feet of the ribs of the roof, so that it may pass under the lower edge of the boards. A thin board should be placed under this in the front to raise it slightly at that part, in order that rain falling on it may flow towards the back—at some point of which an aperture must be made and a small leaden or zinc spout attached, so that the water may be conducted into a covered pan sunk in the ground, and may subsequently be used for garden purposes.

The boarding of the roof should be begun at the bottom. The boards should be about 4″ wide and ½″ thick.

It will at once be understood that as these boards are laid horizontally across the ribs, they will form part of surface bending downward; and that, therefore, whilst their edges on the upper surface will meet, this will not be the case on the under-side: they will, in fact, touch only on the one extreme angle of the edge; whereas the whole surfaces of the edges of both boards should touch. This may readily be accomplished by slightly planing the edge to a bevelled or slanting form, so that the back of each board may be a trifle broader than the front. Fig. 58*a* shows the form of the boards, and Fig. 58*b* their position when placed.

The boards should be nailed over two opposite sides in the first instance; they should be allowed to be a few inches too long at first, and when they are nailed on, this superfluity may be first sawn off, and then the ends may be brought to the exact curve by means of the drawing-knife.

When the two sides have been thus covered, the other two are to be proceeded with in the same manner—the ends of the boards passing over those of the two sides already completed.

The extreme angles may now be cut away by the aid of the drawing-knife, and a good-sized cane may be nailed on, which will give a very pretty finish to the angles of the roof; and laths, about ¼″ thick and 1″ broad, may also be nailed over the joints of the boards.

The central piece to which the ribs converge may be either turned or hewn out into a simple form—such as that sketched in Fig. 59. The upper part may be separately made, and may be attached by a tenon to the lower block; and into the mortise, the top having been removed, a small flagstaff may be inserted on *gala* days. The lower end of the block may also be turned or carved, and a hook may be screwed into it, and to this a wire basket containing a pot of some pendent plant may be attached.

The tops of the uprights should be crowned with a moulding, and a narrower one or beading should be placed about 6″ lower down, so as to give the appearance of capitals to the columns.

The lower panels are now to be filled in; and we here give a very simple pattern for this purpose:

In the first place, each of the square compartments to be filled up is to be crossed by diagonals, made of wood 2″ broad and 1″ thick, halved together at their crossing so as to be perfectly flush with each other, their edges being chamfered off from a short distance from their crossing to the same length from their extremities. These are to be secured to ledges of wood, about ¾″ square, nailed near the front of the timbers forming the frame of the compartment; the cross-pieces are then to be placed, and nailed from the back. The ledges must be chamfered in their edges—their ends, too, being slanted off with the chisel, so that they may form a portion of the design instead of appearing as excrescences.

Before, however, the cross-pieces are put together, a rebate of ¼" must be made in both edges of the back—such as will be found at the back of picture frames to receive the picture—and this is, in fact, the purpose of the rebate here mentioned, the panel representing the picture.

The panels are to be made of wood ¼" thick, and this should be as far as possible free from knots.

The pattern should, in the first place, be drawn on paper; and in designing it, the amateur must bear two points in mind: 1. That both the forms and spaces should be equally distributed—that is, that large masses of pattern should not be placed at any one part, leaving others vacant, but that the forms must be well balanced. 2. That the pattern must be adapted to the material in which it is to be executed; and, as, in the present case, that material is wood, the various lobes of the foliage must so touch each other that their points may be supported, otherwise they will be easily broken off.

If only one panel were required, the pattern might be transferred to the wood direct from the paper; but where a number are to be sawn, the better plan is to cut the whole out in cardboard, and placing this on the wood, scribe round the design with a pencil.

And now let us proceed to the sawing, or rather let us first describe the construction of the Turning-Saw, shown in Fig. 3, page 4.

This useful tool consists, in the first place, of two side-pieces, kept apart by a cross-brace inserted into them by a tenon at each end, but not fastened. Through the lower ends of the side-pieces the iron ends of the handles pass, and into slits in these the saw (which varies in breadth from little more than $\frac{1}{16}$" to ½" or more) is inserted, being secured by pins, which pass through the handles and saw.

A cord is wound around the top of the frame, so as to connect the extremities of the side-pieces, and this is tightened by a straight piece of wood twisted round in it; this is prevented returning by

the cross-piece which keeps the sides apart. The whole is thus firmly braced up.

In commencing to saw out the pattern, a hole must, in the first place, be cut at some convenient spot by means of the brace and bit. The pin which secures the saw at the end most distant from the hand is to be withdrawn, the cord having previously been slightly loosened by being untwisted. The frame must now be held carefully, so that it may not fall to pieces, whilst the saw-blade is passed through the hole in the wood, and then replaced and pinned in its place in the handle, the frame being again tightened up.

The panel should be held in the bench-vice, or by some kind friend who may volunteer his (or her) assistance, whilst the sawing proceeds. The blade being thicker at its edge than at the back, frees itself as it is turned into the curves, and it is, of course, kept stiff by the frame.

When the position of the saw is such that its action is impeded by the frame, the handles must be slightly turned, by which the relation of the frame to the blade will be altered, and the sawing can proceed until a similar re-adjustment again becomes necessary. Care must be taken that the handles are equally turned, so that the blade of the saw may be kept flat, and not in any degree twisted, in which form it would be likely to snap. As little force as possible should be used in working the saw, so that it may follow the drawing in a graceful and smooth line, and it should be held exactly at right angles to the surface of the board, so that the sawn edges may not slant inward or outward.

It will help the amateur in his first attempts at turning sharp corners to cut holes at these points with the brace and bit: these will afford, as it were, havens of rest, from which the saw may start again in a direction different from its former track.

After a little practice in the use of the turning-saw, the curves will be found to require very little "touching-up;" but at first they may

require finishing with the spokeshave, chisel, half-round file, and sand-paper. These sawn panels may either remain open, or another board may be nailed behind them to form a ground, which, when coloured differently from the pattern, has a very pretty effect: the open work has, of course, a lighter appearance; but these are matters of taste which will best be judged of by experiment.

The pavilion here described is one of small dimensions and simple construction; but the amateur carpenter will soon discover that by a free application of the general principles laid down, he will be able to construct one of greater pretensions. For instance, the uprights may be higher, the area being, of course, extended, and thus a "tea-room" may be made below, whilst a "smoking-box" may be made in the upper storey. This would involve a horizontal beam all round on which the floor joists are to rest, this horizontal being supported by dwarf posts of the height of the lower apartment, which must be bolted or screwed to the original uprights.

The floor joists should be carried about 2′ 0″ beyond the wall on the front of the pavilion, and boards having been nailed over these, a balcony will be formed, to which and to the upper room access is obtained by steps on each side—the balusters being carried on so as to form a railing in front of the balcony.

The same arrangement (excepting the steps) may, if desired, be carried out at the back; but in extending the balcony to the sides a rather different plan must be pursued: short joists must be cut to the required size, and about 6″ longer, which extra length is to be formed into a strong tenon; and mortises having been cut in the joist running parallel with the sides, the tenons are to be inserted and fixed by a wooden pin driven through the ends which protrude through the joist. A railing must then be carried all round. In addition to the support thus obtained, a bracket will be required under each of these short beams, and also under each angle of the balcony.

These should be constructed on the principle shown in Fig. 16, and when great care has been taken to insure their strength, they may be ornamented as much as their designer may think proper. The ends of the joists may be carved, or may be covered by a board cut with an ornamental pattern.

The open spaces between the uprights in the lower part of the pavilion may, where not sawn out ornamentally, be covered in with boards nailed against strips of wood, as shown in Fig. 56. The upper portions may be fitted with Venetian blinds or drapery to afford a grateful shade, or a very pretty kind of shutter may be made in the following manner, which the Author remembers having seen beautifully carried out in some Oriental buildings in the grounds of the Paris Exhibition in 1867.

Plane up several feet of wood 1″ × 1″, and mark them off into squares; through the middle of each square bore a hole ¼″ diameter. This should be done with the brace and bit, so that the holes may be smooth and clear. The strips are then to be cut into cubes, and similar holes bored at right angles to the others. These, however, need only be ¼″ deep on each side.

The angles of the blocks are to be cut off with the chisel or gouge.

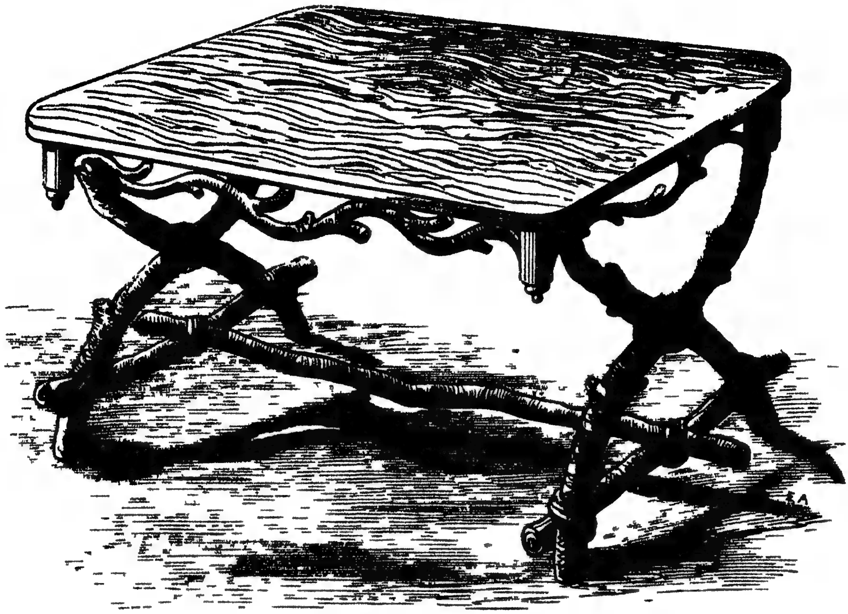
Next plane up several strips of wood, and round them first with the plane and then with sandpaper, until they are precisely ¼″ diameter. On these strips the blocks are, as it were, to be strung like beads at a distance of 1″ from each other, the length being laid aside as fast as finished.

Several more strips similar to the last are now to be cut in pieces of 1½″ each, and these being inserted into the holes on the sides of the blocks will unite the strips into a strong network, shown in Fig. 60. This is to be enclosed into a framing made of wood, about 1½″ broad and ¾″ thick, of course fitting precisely into the aperture.

At the back of these screens red, green, or any other coloured silk

may be attached, and the rays of the sun passing through these produce a beautiful effect on all within. The screens may be attached by rings and hooks in the same manner that pictures are hung.

The uprights may be made of trunks of trees in their natural condition, their branches being merely cut away where the form would materially be interfered with. A rustic appearance would thus be given to the structure, and the term "arbour" would thus be realized.



A GARDEN TABLE

(Fig 61)

It is needless to point out, in the first place, that a Garden Table should be as rustic or appropriate in character as possible—that is, provided that the structure and form is consonant with the material of which the table is made.

We object to tables made of cast iron in which the form is that which would be composed of trees, in which the principles of strength are defied; for the form which, owing to the fibrous quality of wood, would be the better in the one case, is, in consequence of the crystalline formation of cast iron, unfitted for the other. This principle holds good in every kind of design, viz., that the pattern should be such as shall be specially adapted to the material in which it is to be constructed.

We do not, however, wish to be misunderstood, and it is therefore necessary to explain that we do not, in the foregoing remarks, wish to

imply that, although a rustic table is to be made of rough branches of trees, it is to be *so* roughly constructed as to be inconvenient or useless. The very fact of constructing a table implies progress of civilization and the use of tools; for in a savage state each man devours his brother from off the bare surface of his mother earth. Nor do we mean that because a table is rustic in form, it is to have such sharp branches and thorns projecting, that when ladies have gathered around it, shreds of their dresses remain impaled upon them; but we mean that the natural material best adapted for the purpose should be selected from those at hand, and that the construction should be a reality—not a sham.

Our instructions will thus be reduced to very narrow limits: the foregoing sketch must be taken as a general design only, to be altered or improved upon according to circumstances or taste.

It consists, in the first place, of two sides in the form of the letter X. These must be flattened at their junction by cutting away some of the highest portion of their roundness, but they should not be absolutely *halved*. They are then to be bound across in both directions with green osier or other thin twigs or rushes. These are common enough in the country, and in towns may be obtained at any basketmaker's. Four nails or pins made of hard wood should also be driven into the crossing to give additional strength.

The upper and lower ends are next to be cut, so that they may be in the same horizontal line; and a cross-piece is to be nailed at the top, uniting the ends and forming a brace for the attachment of the slab which is to constitute the surface of the table.

The feet are to be united at their lower ends by cross-pieces made of small branches fastened in a manner similar to that already adopted, and the sides may now be screwed or nailed to the top, which should be made of as prettily-grained wood as can be obtained. It should not be French polished, but merely wax-rubbed, by which means the grain

will be well brought out, and quite as much gloss as is required will be obtained.

A "foot bar"—*i.e.*, a branch uniting the cross-pieces—may now be added. It should rest on the cross-pieces, to which it should be bound and nailed.

A pendent may be inserted at each corner, and a border formed of small branches with acorns, fir-cones, &c., may be added. The legs, &c., should be neither polished nor painted; the bark gnarled, cracked, or tinted here and there is sufficiently ornamental to dispense with any other adornment.

A GARDEN CHAIR
(Fig 62.)

This is merely a further development of the system on which the garden table has been constructed. It consists, in the first place, of the X-shaped side, the one portion of which is, however, very much longer than the other, and these longer pieces should be so chosen that the smaller branches proceeding from them should, on being tied together, form the top of the back.

The legs of both the back and front should be connected near the bottom by cross-pieces, and similar pieces must be nailed at the top of the front to form the edge, and near the middle of the back, on a level with the former piece. Before the lower cross-pieces are attached the

two parts must be crossed, and holes having been bored, large screws are to be passed through them into a central bar, which should be made of a branch as nearly straight as can be obtained. The screws best adapted for the purpose are those called "bed-screws," *i.e.*, such as are found in wooden bedsteads, the large heads of which may be covered by a knob, or "boss," made of a piece of a branch, similar to that into which the screws are driven.

The back may be filled up with smaller branches diverging from a larger one in the middle, or by twigs interlaced into a reticulated pattern, according to taste.

The seat is to be formed of a piece of carpet nailed to the cross-piece in the back, and around the corresponding piece in the front. The chair can then be folded after the fashion of a camp-stool, which form is more convenient for carrying about than if the parts were all fixed.

It is scarcely necessary to add that this method should not be adopted in the construction of a garden-seat or bench, which should have upright legs, the hinder ones being continued to form portions of the back. Legs and cross supports will also be required at intervals between the outer supports, all of which details will no doubt be easily understood by the amateur who has successfully accomplished the work already described.

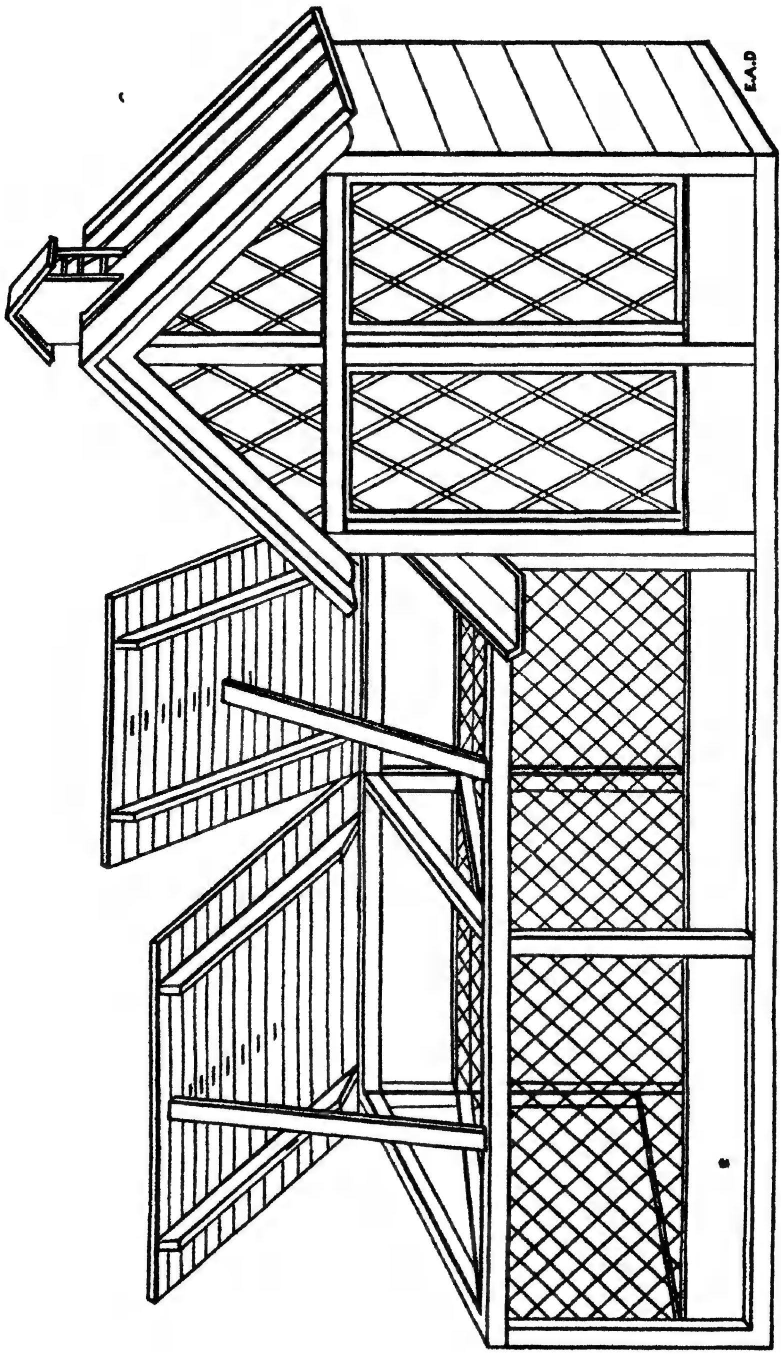


Fig. 63.—A CHICKEN-HOUSE.

A CHICKEN-HOUSE.

(Fig. 63.)

In the pavilion and garden house the methods shown have been such as are based on the actual principles of building construction, both structures being intended for human inhabitants, and therefore requiring all the strength and stability that practical art can give. Now, we do not by any means wish to imply that the plans laid down here are to be devoid of, or in opposition to, those principles, but we wish to put the amateur in a position just to "run up" a little dwelling for a few household pets, even though he may not yet have acquired the power of making a good mortise-joint, and though his ambition, or his time to gratify it, may not extend to the more important works we have described.

We will assume, then, that the ladies in the house have enunciated the idea that real new-laid eggs are much to be preferred to those purchased as such—that the children, be they our sons and daughters, brothers, sisters, nieces, or nephews, have expressed their desire to keep chickens, and that a friend has offered us some which he assures us come from a stock of the highest class—and that we wish to construct a simple dwelling for the future little charges, for charges they will be; and unless a proper dwelling is provided, and unless arrangements are made, by which their health and comfort are ensured, it is wrong to entertain the notion of receiving them. This refers not only to fowls, but to all pets. We are too apt to keep animals for our own amusement, forgetting that the poor dumb creatures might often (if they could) quote the old fable, "that which is amusement to you is death to us."

The question of building a Chicken-House is, therefore, not one of construction only. There are certain conditions to be fulfilled; and in

order that these may be clearly brought before the amateur carpenter, we give the following hints, based, for the most part, on the copious instructions on poultry contained in "Cassell's Household Guide." The first essential requisite to success in poultry-keeping is a thoroughly good house for the birds: this does not necessarily imply a large one or a costly. It means simply that the fowl-house must combine two absolute essentials—be both perfectly waterproof and well ventilated; and with regard to the first point, it is not only necessary to keep out the rain, but also the wind—a matter seldom sufficiently attended to, but which has a great influence on the health and laying of the inmates.

The cheapest material is wood, but if so built, the boards should either be tongued together, or all the joints should be carefully caulked, by driving in string (or tow) with a blunt chisel. Care should also be taken that the door fits well; so that, although the fowls may in fine and sunny weather enjoy both air and light, they may in cold and damp weather, and at nights, be secured against draughts and wind.

For the roof, tiles alone are not sufficient, and if employed, there should oe either boarding or ceiling under them, otherwise all the heat will escape through the numerous interstices, and in winter it will be impossible to keep the house warm. Planks alone make a good roofing: they may either be laid horizontally, overlapping each other, and the whole well tarred two or three times first of all, and one coat being applied every autumn afterwards; or perpendicularly, fitting close edge to edge, and tarred, then covered with large sheets of brown paper, which should also receive two coats of tar. This last makes a very smooth waterproof and durable roofing, which throws off water well. But, on the whole, board, covered with patent felt, which should be tarred once a year, is to be preferred.

In the north of England, a house built of wood, unless artificially

warmed, requires some sort of lining. Matting is often used, and answers perfectly for warmth, but unfortunately makes a capital harbour for vermin. When used, it should only be slightly affixed to the walls, and should at frequent intervals be removed and well beaten. Felt is the best material, the strong smell of the tar repelling most insects from taking up their residence therein.

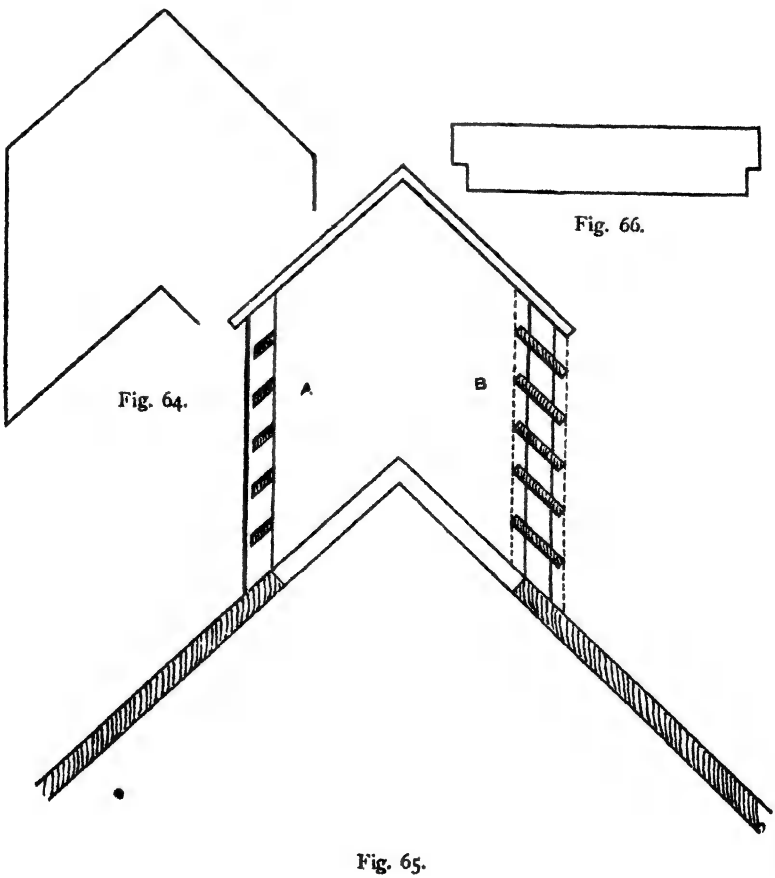


Fig. 64.

Fig. 66.

Fig. 65.

Ventilation is scarcely ever provided for as it should be, and the want of it is a fruitful source of failure and disease: an ill-ventilated fowl-house must cause sickly inmates. This great desideratum must, however, as already observed, be secured without exposing the fowls to

any direct draught, and for the ordinary detached fowl-houses the best plan is to have an opening at the highest point of the roof, surmounted by a lantern of boards, put together after the well-known fashion of Venetian blinds. A south or south-east aspect is desirable when it can be had, and to place the house at the back either of a fireplace or stable is a great advantage in winter; but it has been proved, by long experience, that both can be successfully dispensed with if only the two essentials are combined, of good ventilation and perfect shelter. For about half a dozen fowls, a very good size is 5′ square, and sloping from 6′ to 8′ high. The nests may then be placed on the ground at the back, where any eggs can be readily seen, and one perch will roost all the birds, though of course others may be placed at convenient parts if desired. This perch, unless the breed kept is small, had better not be more than 18″ from the ground, and should be about 4″ in diameter. A rough pole, with the bark on it, answers best: the feet cling to it nicely, and bark is not so hard as planed wood.

By far the greater number of perches are much too high and small, the one fault causing heavy fowls to lame themselves in flying down, and the other producing deformed breast-bones in the chickens, an occurrence disgraceful to any poultry-yard. The air at the top of any room or house is, moreover, much more impure than that nearer the floor. Many prefer a moveable perch fixed on trestles: in large houses they are useful, but in smaller ones they are needless. If the perch be placed at the height indicated, and a little in advance of the front edge of the nests placed at the back, no hen-ladder will be required, and the floor, being left quite clear, will be cleaned, with the greater ease, while the fowls will feel no draught from below.

Besides the house for roosting and laying, a shed is necessary, to which the birds may resort in rainy weather. Should the house, indeed, be very large, and have a good window, this is not absolutely needed; otherwise it must be provided, and is better separate in any case. If

this shed be fenced in with wire, so that the fowls may be strictly confined during wet weather, so much the better, for, next to bad air, wet is by far the most fruitful source of mischief in the poultry-yard. If the space available is very limited—say five or six feet, by twelve or sixteen—the whole should be roofed over, when the house will occupy one end of the space, and the rest will form a covered "run." But in this case the shed should be so arranged that the sunlight may reach the birds during some part of the day. They not only enjoy it, but without it, although adult fowls may be kept for a time in tolerable health, they droop sooner or later, and it is almost impossible to rear healthy chickens.

Should the range be wider, a shed from 6′ to 20′ long, and 4′ to 8′ wide, may be reared up against the wall. Next to the fowl-house will still, for obvious reasons, be the most convenient arrangement, and it is also best fenced in, as before recommended.

The whole roof should project beyond the enclosed space, to throw the water well off. To save the roof-drippings from splashing in, a gutter-shoot will of course be provided, or the wire should be boarded up a foot from the ground. All this being properly carried out, the covered "run" ought at all times to be perfectly dry.

The best flooring for the fowl-house is concrete, made with strong fresh-slaked hydraulic lime and powdered "clinkers," * put down hot, well trodden once a day for a week, and finally smoothed. The process is troublesome, but the result is a floor which is not only very clean in itself, but easily kept so.

Another very good floor is made by a concrete composed of lime, gravel, and water, well rammed down. On this bricks or brickbats are laid, and the whole grouted—that is, covered with mortar in a liquid state, which should be well brushed into the crevices with a

* "Clinkers," or burrs, are bricks which, from being too violently acted upon by the fire, have vitrified in the kiln.

birch-broom. The floor of the run may be the same, but on the whole it is preferable there to leave the natural loose earth, or cover it with gravel and sand, in which the fowls delight to scratch.

It may be just mentioned, *en passant*, that from this very circumstance these birds are classed as Rasores, or "scratchers." Scratching is with them not merely a habit, but a necessity. They are not provided with teeth: they rake up and swallow together with their food a quantity of small stones and gravel, which, descending into the gizzard, serves as millstones to triturate the grain previously soaked in the crop.

Cleanliness must be specially attended to. In the house it is easily secured by laying a board under the perch, which can be scraped clean every morning in a moment, and the air the fowl breathes thus kept perfectly pure. Or the house may be kept clean by the constant use of a housemaid's dust-pan and a small hoe, after which a handful of ashes or sand, lightly sprinkled, will make the house all it should be.

Another excellent plan is suggested by "The Canada Farmer." A broad shelf is fixed at the back of the house, and the perch placed four or five inches above it, about a foot from the wall. The nests are conveniently placed in the ground underneath, and need no top, whilst they are perfectly protected and are well shaded—to the great delight of the hen. The shelf must, of course, be constantly cleansed. It has yet another recommendation in the perfect protection it affords from upward draughts.

The covered run should be raked clear two or three times a week, and dug over whenever it looks sodden or gives an offensive smell. Even this is not sufficient: three or four times a year two or three inches deep—in fact, the whole polluted soil—must be removed and replaced by fresh earth, or sand and gravel, as the case may be. If the floor be hard, there must be kept under the shed a heap of dry dust or

sifted ashes for the fowls to roll in and cleanse themselves in their own peculiar manner, and this should be renewed as often as it becomes damp or foul from use.

For further information on this head we refer the reader to the book mentioned—the subject of poultry rearing being obviously beyond the scope of the present work. As, however, it is absolutely necessary that the builder should understand the wants of those for whom he builds—just as an architect requires the instructions of the gentleman for whom he is to erect a mansion—we give the following additional hints culled from other authorities.

There is very commonly no special building erected for the accommodation of poultry, but perches and places for rest are provided for them in a cow-house or some other farm building, or in very many cases; when kept by cottagers, they roost on joists of the roof within the cottage itself. In such cases they roam at liberty during the whole day, and find much of their food in the fields and on the road-sides, although the feeding of them with corn and other food is not neglected by the careful housewife. But it is often undesirable, for the sake of the fields and gardens, that so much liberty should be allowed to poultry; nor is such a course possible in towns. They may, however, be kept very advantageously, either wholly or mostly in confinement.

If circumstances permit, it is good for them to be let out for an hour or two daily into a grass field, but it is not absolutely necessary if they are provided with a warm, clean, and well-ventilated house, to which a spacious open court is attached, and are regularly supplied with abundance of food, water, sand, or fine ashes, lime, and small stones, all requisite to their healthful existence. The food must also be of various kinds. Poultry must have supplies of grain or pulse, and of soft food made of the meal of grain or pulse: the kind may depend on the convenience and cheapness; and instead of such food, boiled potatoes may, to some extent, be used. Bran is a very good article of food for

poultry. But the same food without variation should not be given for any considerable time. And it is indispensable that all kinds of poultry be frequently, if not even daily, supplied with green food, as blades of kale, cabbage, cauliflower, lettuces, cresses, chickweed, sow-thistle, &c. It is a pretty safe plan to observe the kinds of food which they like best, and to allow them to choose for themselves. When they have no opportunity of seeking worms, snails, slugs, and insects for themselves, animal food must be given, and the refuse from the kitchen cannot be more profitably employed. It is possible, at some seasons, to give too much food, making the poultry too fat, and diminishing the number of eggs; but at other times, as during the season of moulting, food can scarcely be given too plentifully. Water may at all times be abundantly supplied.

Poultry-houses may be built of any material that is most convenient, but warmth cannot be too much regarded.

A poultry-house of 4′ square should have a yard at least 8′ by 4′, enclosed by latticework or wire netting. The floor of the house, made of clay or other material, ought to be so firm and hard as to admit of its being easily scraped and swept, and this should be constantly done. The court should be provided with a "lean-to" shed on one side, under which the birds may find shelter from sun or rain, and here they should also find sand or fine ashes to fling over themselves, according to their manner, to rid themselves of insect tormentors.

Lime is also necessary for them, large quantities of it being appropriated to the formation of the egg-shells, besides being otherwise required in the animal system. It may very conveniently be supplied in the form of lime rubbish from old walls, in which also occur in abundance such small stones as birds need in order to the trituration of the food in their gizzards.

In places appropriated to hatching it is good to have a fresh turf deposited, to prevent the eggs from becoming too dry, and it is even

recommended that the eggs should be slightly moistened every day. It is said that the inner membrane of the egg is otherwise apt to become hard, so that the young chick cannot break through it.

When purity of breed is of importance, as when fowls are to be exhibited in prize competitions, great care must be taken to keep the different kinds perfectly separate; otherwise intermixture, to a certain extent, is not undesirable. It is always, indeed, to be desired that each good kind be kept pure and in as great perfection as possible, for improvement of the stock. But even in a small poultry-house it is desirable to have different kinds—some being particularly estimable for their flesh, some for the abundance and quality of their eggs, some for their disposition to incubate.

The amateur carpenter will thus see the elements of which success in his work is to be composed. It is of no use to build a house, however pretty or however strong, if the requirements of the inmates are not satisfied; and this must be our apology for thus far diverging from our course of construction, and we will now endeavour to design a neat and compact residence for our feathered friends, which shall embody all the foregoing conditions, and which shall be—whilst at the same time—adapted to a very limited space.

First, then, as to the house, which is one which the author used for many years, and with great success, his small back garden answering the purpose of the courtyard or run.

It has already been said that the present structure is to be designed in a simpler and lighter manner than the pavilion and tool-house, which formed the subjects of previous chapters, and thus the uprights are not to rest on a solid framework, but are to be sunk into the ground, in a method which presently will be described.

The house is to consist, in the first place, of two frames, shaped like the gable side of a cottage. These are to be made up in the following manner: First, a horizontal for the base, which is to be 5′ long and

3″ thick; two uprights, also 5′ long and 3″ thick. These are to be fixed to the horizontal by a process resembling that of halving, namely, that half the thickness of the horizontal is to be cut away at the ends, but not any of the thickness of the uprights, in order that they may retain their full strength at this point. The horizontal is to cross the uprights at 1′ from their lower ends, and is to be attached by strong nails, well clamped.

Before, however, this is done, the upper ends of the uprights must have one-third of their thickness cut away on each side, leaving a central projecting part 1′ thick. The piece cut away, however, must be square on the back only; that in the front must be cut obliquely. The end will then correspond with Fig. 63. The upper horizontal, 2″ thick and 5′ long, is then to be halved on to the inner side of the tops of the uprights. A central perpendicular, 8′ high and 2″ thick in the front gable, and 7′ in that at the back, is then to be halved on to both horizontals, with the upper one of which it will then be flush. The real height of the gable-point is to be 7′, but the extra foot in the front is to be shaped into a ridge-spike, if such be desired, otherwise the uprights are to be the same in back and front.

The principal rafters, made of wood 3″ broad and 1″ thick, are now to be nailed to the ends of the perpendiculars, abutting against the slanting shoulder prepared for them, and meeting on the central perpendicular, to which they are to be nailed. Struts nailed to the middle of these, and to the junction of the central perpendicular with the upper horizontal, will also strengthen and bind the framing together.

The back and front having been thus made, are to be erected in their places. A corner situation is the best—say, where the kitchen or scullery wall meets the garden wall, in which case the side of the chicken-house shown in the sketch would not be necessary. The slanting roof under such circumstances would not of course overhang,

but a piece of bent zinc would be necessary, in order to catch and discharge the water from that side of the roof.

The site having been decided upon, arrangements must be made for fixing the frames. As already stated, there is a great objection to fixing poles by merely ramming them down in garden ground. It is, therefore, necessary in the present case to dig two holes, rather more than 12″ deep, and to place a brick firmly at the bottom of each; the ends of the perpendiculars will then rest on these, and around them, earth, broken bricks, stones, broken flower-pots, &c., are to be well rammed down, using the end of a pole for a rammer, and continuing the process as long as the surface yields to the force of the blows—carefully observing that the perpendicular of the posts is preserved.

The same plan is to be followed in fixing the back frame, excepting that it must be placed close to the wall against which the house is being built, and that therefore the ramming, as a matter of course, will only be in the front. The back frame must further be secured by strong holdfasts, the wall having been previously plugged.

The front and back frames are, in the first instance, to be connected by two horizontals on each side. These should be made of 2″ wood, and should in the clear be 4′ long. They should be fastened to the perpendicular not only by nails driven from the side, but also by some driven from the front of the perpendiculars, by which ties at right angles to each other will be effected. A ridge-piece must also be placed to connect the two gable-points, and against this and the side horizontals two additional rafters must be placed, so as to give support to the middle of the roof boards.

The floor is now to be laid down as above described, and the nests at the back are then to be built. They consist simply of a board 1″ thick supported on cross-pieces 1″ square—just to keep the bottom raised above the floor, in order to secure the hens against any damp that may arise—with upright walls to divide them, a wooden back, and a ledge

about 3″ high in the front, to keep in the hay or straw forming the bed. The shelf already described may either rest upon brackets or on a ledge fixed against each end wall, requiring only one perpendicular support in the middle; and this may well be formed by one of the boards dividing the nests being made higher than the others.

The perch, made of the stem of an old tree, easily obtainable, is to be supported against the end wall, either by uprights or blocks screwed or nailed on.

The sides are simply to be made of boards ½″ thick, overlapping each other and well secured against draught. In the lower part an aperture is to be cut, through which the fowls may pass into the yard; but this must be provided with a trap-door, to be carefully secured at night—thus preventing the entrance of cats. A piece of board running between two grooved ledges will be sufficient to secure the chickens against feline depredators. If human "fanciers" are likely to visit the house, other means should be adopted.

The spaces in the front—forming, as it were, panels—are now to be filled up; but before taking that portion of the work actually in hand, a board of 9″ width must be nailed along the bottom, in order to prevent draught on the hens whilst in the nests, and to prevent splashing of violent rains.

The four apertures must then be accurately measured, and frames made of wood ½″ thick and 1″ wide, to fit them exactly, observing that the framing for the left-hand panel is to form the door, and must therefore be made of wood 2″ wide and ¾″ thick. Across these laths are to be nailed either in diamond or any other pattern, or they may be filled in with wire netting. The frames thus completed are then to be fixed in their places—that is, the three are to be nailed, whilst the fourth is to be attached by hinges to the central upright, to open outward, and this should be fastened either with a lock or a padlock: the latter will, perhaps, be found the best.

In order to secure the fowls against cold, a thick canvas curtain may be made, which may be hung up by means of rings to hooks placed on the inside of the rafters. This may be taken down in the day-time, and replaced at night; or shutters may be made of ½" boards, which should fit exactly into the frames already described, and should be secured to them by turning-buttons. This plan affords very efficient protection against cold, and a certain amount of air and light is insured by a few holes being cut in the shutters by means of the brace and bit.

The roof is now to be covered in with boards laid next to each other, the ends projecting about 4" beyond the front of the main building—the joints being covered with fillets nailed outside.

And now we must make a ventilator, and to do this the following plan is to be worked out:

Cut away the board on each side of the ridge in the middle part—that is, between the two middle rafters—so as to leave an opening about 10" square (the boards will be most conveniently cut before they are nailed in their places), and on the edges of this opening, which are parallel to the gables, nail ledges of wood 1" square. Now prepare two pieces of board ¾" thick, of the shape of Fig. 64, the bottom of each to be cut to fit the angle of the roof, and these are subsequently to be nailed on to the ledges on the edges of the aperture.

Plane up four pieces of wood 2" wide and ¾" thick, and cut them to fit the upright sides of the pieces shown in Fig. 64. In these strips cut slanting grooves, ½" deep and ¼" wide, which are not, however, to be carried across, a ledge of ½" being left. This is shown at A in Fig. 65, in which the strip is in its place. The pieces to fit in these grooves must be cut as shown in Fig. 66; and when the ventilator is fixed in its place, the narrow part will pass between the ledges, whilst the broader part will fit in the grooves, as shown at B in Fig. 65.

The parts being thus prepared, and the sides nailed or screwed in their

places against the ledges, the ventilating leaves are to be placed in their grooves, the whole being covered and braced together by the two boards forming the roof, which should project a couple of inches on all sides. In larger houses—in coach-houses, stables, and sheds—these ventilators may be placed at certain distances, or one may be made to run the whole length of the roof. The dwelling being thus completed, we proceed with the "run" or playground.

In the first place, construct a frame, 10′ long and 3′ high *in the clear;* for, as the two uprights are to be sunk 1″ in the ground, they will be 4′ long. The uprights and upper horizontals are to be made of wood 2″ square; but the lower horizontal is to be 3″ square, and above this a board 9″ wide is to be nailed.

A similar frame is to be made for the back, but with the following exceptions: (1.) That a board at the bottom is not necessary, as the fowls like to peck into the mortar of the wall. (2) That the perpendiculars are to be halved on to the horizontal in such a manner as to pass it, and are to be sufficiently high to reach within an inch of the eaves of the chicken-house. On these another horizontal of the same thickness as the front one is to rest. This framing, in addition to having the ends of the perpendiculars sunk in the ground, must be strongly attached to the wall by means of holdfasts driven in near the top of the perpendiculars and immediately under the upper horizontal.

Cross-pieces from back to front must, of course, be added: the lower one of the end, like that in the front, supporting a board 9″ wide; and cross-pieces should also be carried over the top from one perpendicular to another.

If larger dimensions than those indicated are adopted, more perpendiculars will be required, and angle struts, diagonal braces, and other methods of strengthening the structure must be adopted. These may, however, fairly be left to the inventive and constructive powers of the amateur, it being manifestly impossible to give instructions which shall

meet every emergency; nor is such a course desirable, for it is in the very circumstance that the mental powers are called into exercise, and that ingenuity is required in accomplishing certain results, that the real pleasure is obtained—the manual work being merely the means to the end.

The whole of the top and sides of this area are to be covered in either with latticework or wire net. For this particular part the latter is preferable, whilst the former looks better in the panels of the chicken-house itself—in which, however, it may be placed at the back of the latticework, where it not only improves the appearance, but affords additional protection against the nocturnal visits of cats, or perhaps rats, which might manage to squeeze through the diamond-shaped apertures.

Now, it will be clear that the rain pouring down the side of the roof of the chicken-house, would deluge the run; and to prevent this, the portion—say about 8″ broad—immediately under and adjoining the eaves is to be covered in by boards, nailed to the upper horizontal and to that of the front, beyond which it should project by about 6″, and this boarding should, in the edge next the run, be supplied with an upright edge about 3″ high, so that the water may not pass over it, but may be conveyed directly downward.

It has already been said that the chickens, although they do not care to stop at home in their house all day, still like occasionally to retire from the glare of the sun, and to sit in the shade, rubbing themselves with dust, and indulging in such quiet amusements as appertain to their class, and it has been further pointed out that the run should be kept dry.

In order to meet all these requirements, a light movable roof is proposed. This should consist of two or more parts, according to the size of the run, and may be made of ¾″ boards crossed by rabbets 2″ deep and 1″ wide, the boards being nailed to the narrower side of the rabbets. The joints should be covered with laths, in order to make them watertight. These shutters are to be attached by hinges to the

upper horizontal; the hinges, by the way, should be the long ones, so that whilst the one part may be screwed to the horizontal, the other may extend some length across the shutters. When both shutters are down, a slip of wood should be nailed to the one to cover the joint, and of course, in opening, this one should be raised first.

Now, there are two ways of raising the shutters. We first give the method adapted for a small structure, such as that in which we have been engaged.

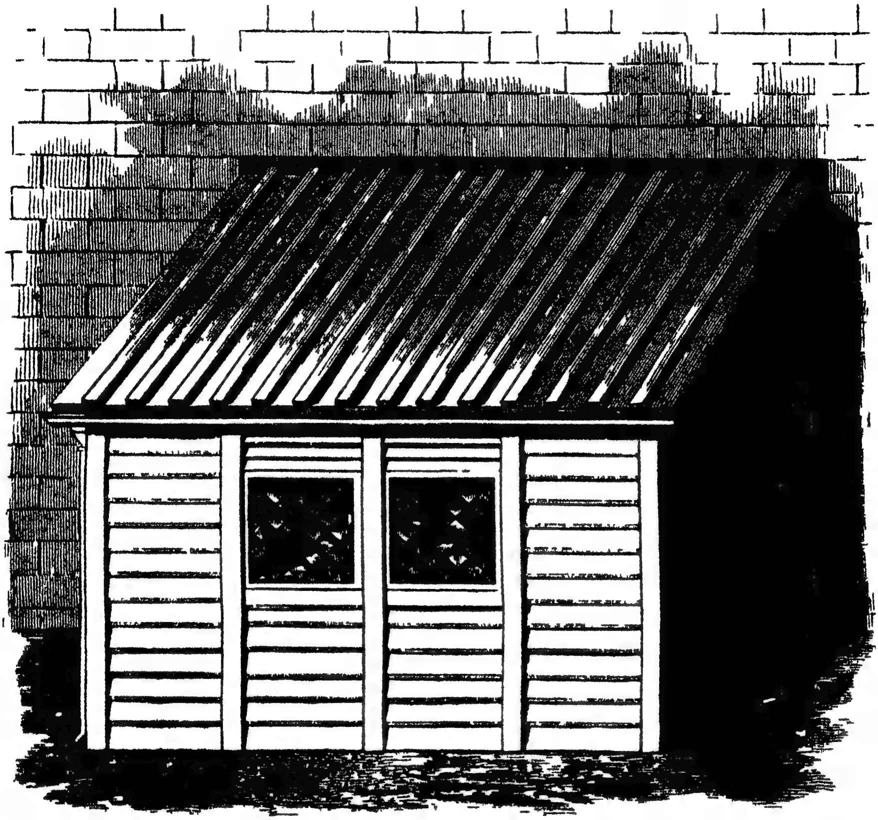
To each shutter a stick of wood, say $1\frac{1}{2}'' \times 1''$, is to be attached by a loop and hasp: the former screwed into the stick; the latter driven into a block fastened to the shutters or to a plate, which may be screwed on—the length of the stick to be enough to reach from the shutter when almost upright to the front horizontal, where its lower end should abut against a block screwed on for that purpose.

On the cross-pieces, both at the end and middle, triangular pieces should be nailed to fill up the spaces between the horizontal and the slanting shutter. These will add materially to the support of the covering, or the same purpose may be accomplished by slanting pieces as shown in the sketch.

For larger structures perpendiculars must be carried up against the wall, and ropes fastened to the shutters must be passed over pulleys in these; the shutters are then raised by pulling the ropes.

For convenience in cleaning, either or both of the compartments of the front may be made to open like the door of the chicken-house, to admit a boy, or to allow of the introduction of a hoe, rake, or besom. It will be well, too, to arrange the boards at the bottom so that they may be taken off occasionally, whilst the whole floor of the run is flushed with water, so as to give it a regular cleansing. To aid in this the floor should be laid so as to incline slightly towards the front.

We have here given the mere structural arrangements, leaving all ornamental additions, painting, &c., to the taste of the amateur.



A GARDEN HOUSE,

FOR IMPLEMENTS, ETC

(Fig 67)

We cannot possibly keep everything in its place unless we have a place for everything, and a design from which a gentleman carpenter may be enabled to construct a simple Garden House, or Tool-Shed, is therefore given. The garden engine, wheelbarrow, garden-roller, spades, rakes, hoes, &c, stores of empty flower-pots, odd pieces of timber used in repairs, &c., may all be here safely put out of sight, and much inconvenience and loss prevented.

The shed is to be what is called a "lean-to," that is, it is to be built against a wall, which is, indeed, to form the fourth side. It may, in

fact, be found convenient to build it against a door of a back kitchen or outhouse, and thus access may be obtained from within when snow or rain may prevent the outer door being used, an advantage which, if the shed is to be used as a workshop, must not be overlooked.

It must, however, be pointed out that a building so constructed would not be very well adapted for the finer branches of the art described in these pages, as the tools would be liable to rust; but it is very convenient to have a place handy where little repairs to garden seats, gates, doors, &c., may be done, and for these purposes the necessary tools may be brought in the tool-tray from the indoor workshop.

Although the shed is called a "lean-to," its weight should not really lean against the wall, nor should it press outward in a way calculated to draw the whole structure out of its place; the entire pressure should be vertical, and weight should tend only to keep the different parts all the more safely in their places.

As in the case of the pavilion, our first object must be to prevent sinking, and we purpose, therefore, constructing the shed on a foundation framing, as in the former case.

The external dimensions of the shed are to be 12′ in the front and 6′ at the side, and a frame of wood 6″ square is therefore to be constructed, remembering that the pieces are to project 6″ at each end beyond the crossing, mortises 3″ square being cut at the intersections.

It will naturally strike the amateur that these projecting ends will prevent the long side of the frame touching the wall at the back; but when the trench into which the frame is to be sunk has been made, a hole, 6″ square, is to be cut in the brickwork of the wall on a level with the trench, so that the ends of the frame may be inserted. These two apertures are to be cut with bricklayers' or masons' chisels, a piece of one of the bricks near a joint being chipped off first, and the opening increased until of the right size and depth, and so that the timber may rest on a course of brickwork. When this has been done suffi-

ciently to allow of the back piece of the framing being brought close to the wall, the aperture around the inserted end should be filled up with mortar and pieces of brick well driven in.

Two ends have been spoken of, but as the length of the shed is to be 12′, a third truss such as that we are about constructing will be necessary. The form is shown in Fig. 68.

The height of the eaves is to be 7′, and this will be the length of the uprights in the front, A, from shoulder to shoulder. They are, however, to have square tenons of 6″ length at the bottom, and 4″ at top. They are to be made of wood 4″ square, reduced to 3″ for the lower and 2″ for the upper tenons.

The perpendiculars at the back, B, are to be 12′ high in the clear, with a 3″ square tenon at bottom, and a flat one 1″ thick, but the breadth of the whole wood (4″) at the top, the tenon to run parallel to the wall when the upright is in its place.

The three trusses are to be united at the back by a horizontal timber, 4″ square, in which mortises are to be cut, so that it may drop on to the tenons already described. The end of this is shown at C.

Speaking practically, there would, if all the work were well done, be no necessity to fasten this back frame, as the design is such that the whole weight of the structure tends to press this against the wall, and so keep it in its place; but the ground may be deceptive, or may give way after heavy rains, or, the timbers may twist or contract, and thus injure the joints; and it is therefore, best to be on the safe side, and drive a few holdfasts at intervals into the wall, which must, of course, be properly plugged first. These should not be driven in too tightly, for if there be any inequality in the surface of the wall, and the ends of the wood are strained tightly over it, a state of resistance would be established, which must result in loosening one or other of the holdfasts.

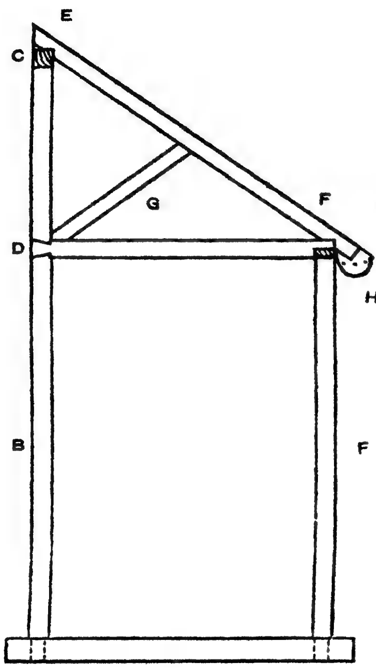


Fig. 68.

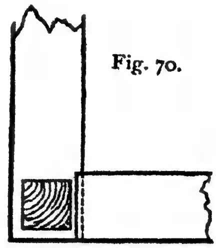


Fig. 70.

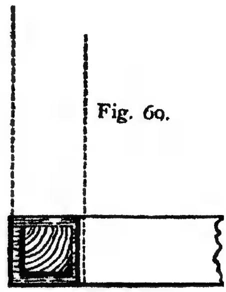


Fig. 69.

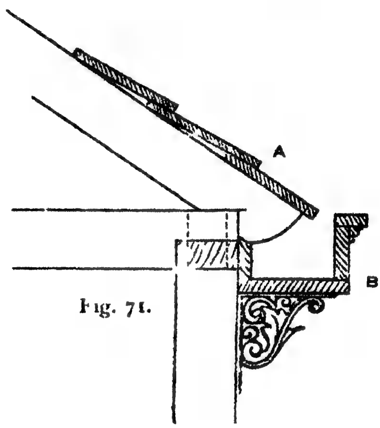


Fig. 71.

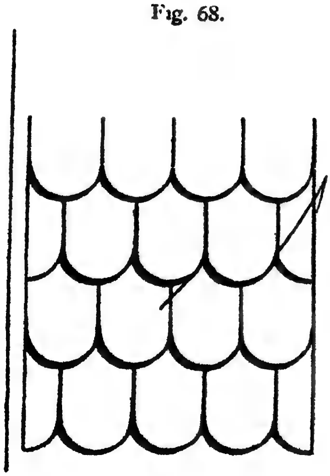


Fig. 72.

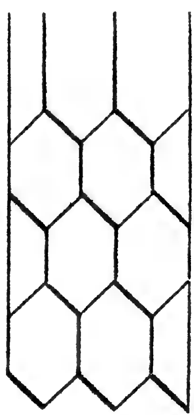


Fig. 73.

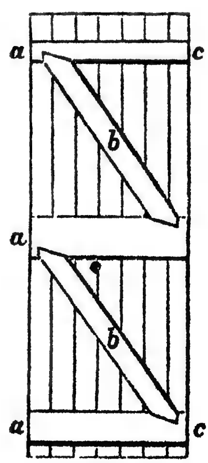


Fig. 74.

The method of uniting the upper framing with the uprights now demands attention. The horizontals from both sides and front are to meet on the uprights at the angles, and are to form a flush surface. They must, therefore, be halved together.

It must be borne in mind, however, that in halving, as we cut away half the wood, we take away half the strength; and as the horizontal in the front has to bear the weight of the ends of the rafters, it is desirable to give it as much support as possible.

The piece removed for halving should, therefore, be 3¾", instead of 4", and when the mortise has been cut, the horizontal should be placed on the tenon, the *cut side upward,* Fig. 69, so that the weight will rest on the whole length of the fibres, which will receive additional strength from the circumstance that those above them rest on the upright at each end, even though the bearing be only ¼". Mortises are, of course, to be cut in the horizontal, to receive the tenons of the intermediate perpendiculars.

The horizontals at right angles to the front are to have the piece removed for halving in the under side, and the breadth must be decreased by ¼", to allow for the extra ¼" left on the front horizontal. This is shown in Fig. 70.

This piece is to be attached to the back upright by the dovetail notch, D, Fig. 68, and it thus acts as a tie-rod, securing the whole of the front from any outward tendency.

And so we reach the roof, the "lean-to," or shed-roof, being the simplest one used. Of course, the first idea of a roof is that it is to cover the area underneath, and this purpose would be accomplished by merely boarding over the top; but this would not discharge the rain, and would certainly afford a lodgment for snow in climates such as this. A slanting roof, therefore, becomes necessary, and with this arises the difficulty of preventing the walls being forced outward at the top. The general characteristics of roofs will be considered further

on. We will now proceed with our present undertaking, and describe the very simple construction necessary: this consists of rafters resting on the cross-pieces of the back and front.

If these were simply laid across the horizontals, they would of course slide downward until the upper end, being set free, it would fall inward; but the whole of such result is prevented by the operation called "notching on" the rafters to the horizontals. This consists in simply sawing out a piece at top and bottom of the rafters, the cuts to be absolutely at right angles to each other, and it will then be seen (E, F,) that the whole weight presses downward, and not obliquely, the rafters merely requiring steadying by a couple of nails driven in at right angles to the joist on which the rafters are to rest. The rafters should project beyond the front by a few inches, so that rain-water may be carried away from the surface. The rafters for this roof should be about 4″ × 3″, and it must be borne in mind that much greater strength is gained by increasing the depth than the width of rafters or floor-joists.

Although only the three trusses have been spoken of, it is now convenient to remark that between these, several rafters of precisely the same form and size are to be placed, at about 1′ or 10″ apart, and it has already been mentioned that the number of trusses must be increased, according to the length of the building.

An important addition to the trusses is a strut, or oblique support, G, placed so that one end may be about the middle of the rafters, and the other in the angle where the horizontal meets the upright. It must be pointed out that the shoulder of the tenon of this strut must be at right angles to length, and that the mortise to receive it must be cut accordingly. It will now be seen that the weight of the whole roof tends towards, instead of from, the wall.

Having thus described the general construction, we must return to the earlier portion of our work, which should be attended to before the different parts are put together.

Where the shed is to face the garden, it is desirable that the window should be in the front. In the present design the window is to be a double one, and is placed between the uprights, into which the sill and architraves are to be mortised. The framing will be spoken of presently.

The doorway is to be placed on one of the sides, and is to be filled by double doors, one of which is to be furnished with bolts to work into the framing above and below, and to this the second door is to be locked. The purpose of a large and double door is that the garden engine, barrow, or even small hand-cart, may be taken in. If the space left by the two uprights and horizontal in the end should be too large for the doors or door required, an aperture of the desired size may be made by adding intermediate uprights and a horizontal between two of them. These should be mortised into the framing as the other uprights are.

If the garden house has been built as suggested against a back door of the house, the door of the shed must be securely bolted and locked from within, so that access to the house may not be obtained through it without permission of the inmates. It is scarcely necessary to make any further suggestion on this head, as several methods which have been adopted in similar situations will no doubt occur to the mind of the amateur carpenter.

In the event of larger dimensions than those given being adopted, diagonal braces should be placed between the perpendiculars; or the spaces between them should be crossed by horizontals mortised into them.

We now proceed with the covering of the walls. Nail around the inner side of each compartment formed by the uprights and horizontals pieces of wood, ¾" thick and 2" broad, their edges being 1" from the inner and 1" from the outer sides of the uprights. A rebate is thus artificially formed on the inner and outer edges. The outer edges of the pieces thus affixed are to serve for the attachment of the boards

which are to form the external covering of the structure; and if it is to be used for any purpose other than that already ascribed to it, and it is required to be warm and free from draughts, boards ploughed and tongued together may be nailed to the inner edges, thus forming a very compact room. These hints are merely thrown out so that the amateur may see that by a little ingenuity a structure, simple in itself, may be improved upon so as to answer numerous purposes, and in these days of emigration there is no telling how useful the suggestions made in these lines may one day prove to some of their readers.

The boards are to be cut the exact length of the distance from post to post—the width, in fact, of the aperture they are to cover. Those next to the bottom are to be nailed on first, and their surface towards the top must be slanted off, so that the overlapping portion of the next board may lie flat on it, instead of merely touching it at its edge. The boards may be 8″ wide, and should overlap each other by 2″ at their upper edge. They are to be nailed to the uprights, and at their lower edges they are to be secured by nails passing through the upper board and the one which it overlaps into the uprights. If it be desired to finish the work very neatly, strips about 1¾″ wide may be planed up, and their edges cut into a saw-like form, to fit into the slant of the boards, these slips being then nailed to the uprights on the outside; in this case the ledges to which the boards are nailed must be set farther back.

Another method is to prepare boards ¾″ thick, and fitting to each other by means of the plough-and-tongue joint; and having attached these to the ledges, strips are to be nailed over them, the boards being thus placed, as it were, in a groove.

The boards may also be placed obliquely against the ledges, the direction being reversed in adjacent compartments, by which a very pretty effect is produced.

In covering the roof, various methods may be followed; thus boards may be placed to overlap each other in the manner already described in relation to the walls, the lower one, which should be fastened down first, projecting slightly beyond the rafters, Fig. 71, A; or battens, or thin pieces of wood, may be nailed at right angles to the rafters, at intervals of about 1′, and the roof-boards may then be nailed to these parallel to the rafters, a lath about 1″ wide and ¼″ thick being nailed over the joint. This is shown in the general view, Fig. 67.

Again, the roof may be covered with shingles. These are flat pieces of board, which are placed so as to overlap each other like slates. These may be prepared in two different ways: 1. By cutting the pieces, about 10″ long, from boards 4″ wide and ½″ thick, and then cutting the one end to the desired form, the boards having been planed first. In order to expedite the work, three or four small boards may be placed one over the other, and sawn through simultaneously. 2. By cutting up pieces of timber 4″ wide into blocks 9″ or 10″ long, shaping the one end of these as may be desired, and then splitting off the shingles from these. When this plan is adopted, each shingle will require planing, and thus it will take more time than the previous method; at the same time it is a very good way of economizing short blocks which might not otherwise be turned to account. The shingles may with advantage be planed rather thinner at the end to be overlapped than at the point. If they are made in the way last described, the wood must be such as will split well, as it is, of course, necessary that the shingles should be perfectly flat. Well-seasoned wood should be chosen, and it is found a good plan to prepare the shingles some time before they are required—to soak them in water and let them lie about the workshop, or in the sun; after this some will be found just slightly bent, and when they have been again soaked, they may bend back again if turned; or perhaps the bend may be so little that it may be remedied with the plane. Others will

be found split, so as to be wholly useless, whilst the rest will remain uninjured. Two forms of shingling are shown in Figs. 72 and 73.

All the shingles should be bored before they are taken up to be planed. They will require two holes at top and two near the bottom, at the point where the slant or curve begins.

It may be well to mention that it is desirable that, whilst nailing on the shingles or boards, an assistant below should hold a stick of timber under the batten into which the nails are being driven, in order to support it and give it solidity. When this is done the nails may be driven more surely in, the rest of the work is not jerked and shaken, and the noise is very much decreased. The joints between the shingles will require covering with pieces of lath, in order to prevent water passing between them. Instead of using battens, the whole roof may be covered with boards about 3/8" thick, forming a flat surface, to which the shingles may be nailed. This improves the appearance from below, but, of course, adds to the expense.

The window-sashes may consist simply of frames, made of wood about 2" × 1", into which diamond-shaped panes may be placed, the leaden divisions with the iron frames and bars being readily obtainable; or rectangular sash-bars may be mortised into the frames. The sashes may be made to open on hinges, or may be hung on pivots.

The door for this garden house may be of the kind called "braced and ledged," illustrated in Fig. 74. The boards are either simply planed carefully at their edges and placed next to each other, or they may be rebated, or ploughed and tongued. The ledges, *a a a*, are then nailed across, two nails passing into each board. These must not be in the same perpendicular line, and must be clamped on the other side. An oblique ledge, or strut, is necessary where the doors are large, and this should be formed and placed as at *b b*. Assuming, then, that the hinges are at *c c*, the weight of the upper and after part of the door will be carried inward towards the bearing-points, and

sinking of the front portion of the door, which is so often a source of annoyance, will be prevented. The hinges for the doors should be long ones, screwed on to the ledges.

If a simple cupboard be desired, a few of the rafters may be prolonged beyond the front, so as to rest on another smaller frame, the side being boarded up. A door to this may be made on the inside between two of the uprights. The whole garden house must, of course, be well painted, the colours being such as may best accord with the surroundings. On this head the taste of the amateur will be his guide.

The horizontals of the trusses will be found very useful for stowing away long pieces of timber, &c. Boards may also be laid across them, and thus a temporary floor will be formed, which may be used for placing plants which are to be housed over the winter.

We have spoken thus far of the woodwork, but we must for a few moments step just beyond this special branch, and merge into that of the plumber, for it will at once be seen that there is the possibility of the rain entering at the line where the top of the roof meets the wall. This may be prevented in the following manner: Obtain at a plumber's a piece of sheet lead about 6″ or 7″ wide, and of the length of the roof. With an iron hook or the bricklayer's chisel rake out the mortar from the horizontal joint in the brickwork immediately above the line of the roof, until a crevice about 1″ deep is formed. Now bend an edge of about the same depth along the whole length of the lead, and insert it into the crevice, bending the lead at the roof-line, so that the remaining portion may cover the wall between the crevice and the roof, and the rest lie flat on the roof. This may be done by beating with the mallet or heavy stick. The crevice is then to be made good with mortar, and the lower edge of the lead is to be nailed down to the boards or shingles.

A zinc gutter may be obtained of such form that it may be fastened

under the roof-boards, projecting sufficiently to receive the water and convey it to the spout, Fig. 68, II. Or a very simple gutter may be made in the manner shown at B, Fig. 71, which at the same time forms a cornice, which improves the appearance of the roof.

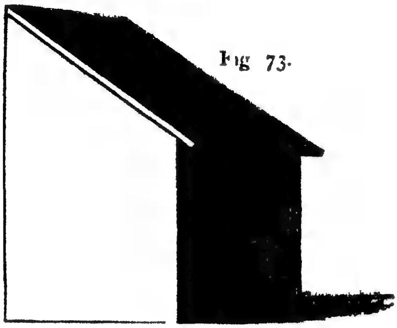


Fig. 73.

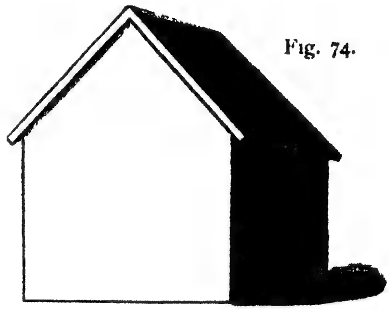


Fig. 74.

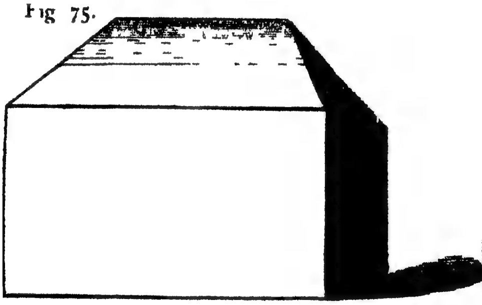


Fig. 75.

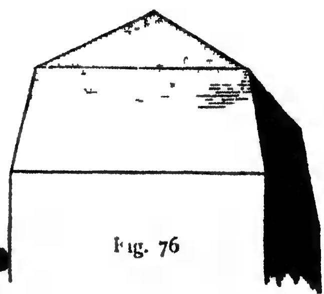


Fig. 76

This is simply a long and narrow box, which should be joined so as to be perfectly water-tight, and should be tarred inside; a narrow moulding may be run round the top; and the gutter should be supported on either iron or wooden brackets.

As we desire in this work to enable the amateur not only to be himself the absolute worker, but to qualify him to design and direct the artizans employed by him to perform such parts of the manual labour as may be beyond his capabilities or wishes, we think it advisable to

give some general information as to roofs, referring the reader for further technical instruction to "Building Construction," "Drawing for Carpenters and Joiners," by the Author of these pages.

Apart from domes there are four principal kinds of roofs: 1. The lean-to (Fig. 73), already referred to, but again sketched here in order that it may be contrasted with the others. 2. The pent or gable, Fig. 74, which consists of two planes meeting in a ridge. 3. The hip roof, Fig. 75, consisting of four planes all slanting inward, and meeting in a ridge which is less than the length of the roof at its base: the two longer of these planes will be trapezoids* or—triangles the upper portions of which are cut off by lines parallel to the bases, and the end planes will be triangles. Closely allied to the hip roof is the pyramidical, in which the four planes are equal triangles which meet in a point, the plan or base of which may be square or polygonal. 4. The curb or Mansard roof, Fig. 76, so called from its having been greatly used by Mansard, a celebrated French architect who flourished during the reign of Louis XIV., and this form is, therefore, generally termed "French roofs"—having been very generally adopted in France. In this roof the planes slant inward, but the pyramid which would be formed if the planes were continued is suddenly cut short, and planes proceed from the truncatory line at a greater slant until they meet in the ridge or apex. The roof is thus made up of eight planes.

Now as to the principles of construction, which we shall confine to the simple gable form.

It has already been pointed out that the tendency of the slanting planes of a roof is to push the walls outward, and this will at once be understood on reference to Fig. 77; whilst it will be clear that if the two lower ends of the roof timbers were tied together by a rope, this spreading out would be prevented. Instead, however, of tying them

* See "Linear Drawing and Practical Geometry," by the Author.

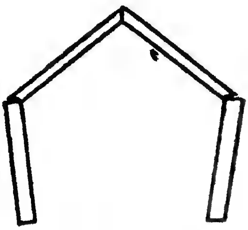


Fig. 77.

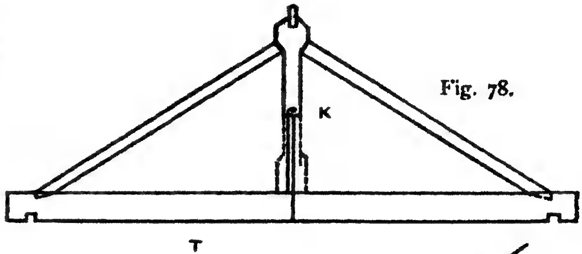


Fig. 78.

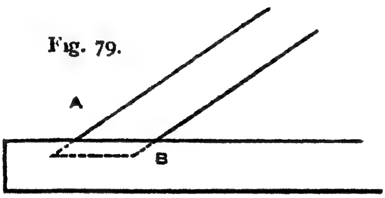


Fig. 79.

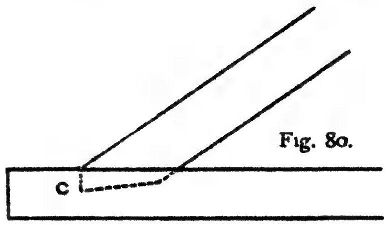


Fig. 80.

Fig. 81.

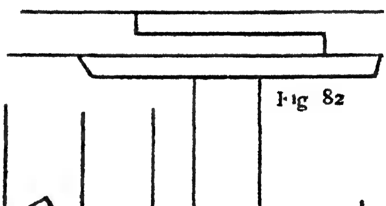


Fig. 82.

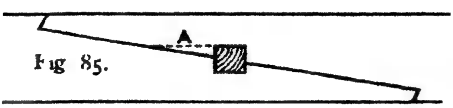


Fig. 85.

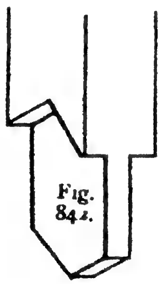


Fig. 84 *a*.

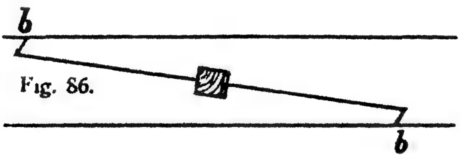


Fig. 86.

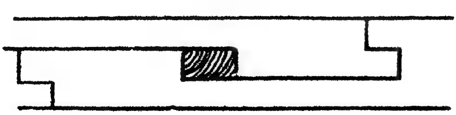


Fig. 87.

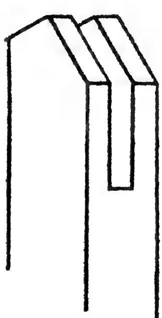


Fig. 84 *b*.

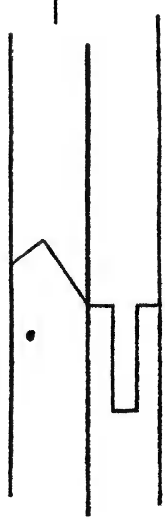


Fig. 83.

together, the ends are obliquely mortised into a beam extending from wall to wall, and resting on timbers built into the brickwork.

This is called the Tie-Beam (Fig. 78, T), and it will be obvious that the thrust of the whole of the roof is transferred to this timber, and that, as this rests on the walls, the pressure is vertical, and not in the least outward. It has in previous subjects been remarked that the end of the rafter should be cut off, so that it may not act as a chisel in splitting up the wood at the point where it is inserted.

This difference will be seen in Figs. 79 and 80, for in the first the weight resting on the rafter would have the tendency to raise the point A, the timber moving on B as a fulcrum, thus splitting off the wood above A; whilst in Fig. 80, at C, the force is stopped by the square block against which the rafter abuts, and the thrust is towards the body of the timber.

The two timbers here referred to are called "principal rafters," or, commonly, "principals," in contra-distinction to "common rafters," which will be referred to presently.

These principals do not at the top abut against each other, but are mortised into a broad piece, called the "King-post."

The king-post is shown at K, Fig. 78, and it is desirable here to correct a popular notion that it rests on the beam, and so gives support to the principals. Nothing can be more erroneous than this, for it is clear that the beam and the two principals form a triangle. The length of the two rafters being greater than that of the base, the apex cannot be drawn down, and therefore, as will be seen in Fig. 78, they really hold up the head of the king-post between them, and it will be evident that any weight might be attached to K, and would be held up by it, and thus a tie-beam may be suspended from it; and this is what is really done. The king-post is cut rather shorter than the altitude of the triangle, and its tenon is loosely placed in the mortise on the upper side of the beam. An iron strap is then placed

around the beam, and is bolted to the bottom of the king-post; or the iron strap is made with a rectangular aperture, and wedges are passed through the king-post: by driving these from each side the tie-beam is tightened up. The whole of this arrangement is described and illustrated in detail in the Author's "Building Construction."

The bottom of the king-post is widened, and a fixed point is thus created, against which struts abut, which give support to the principals. These struts, at the points at which they are inserted into the principals, serve to hold up the upper ends of "queen-posts," around the bottom of which iron bands, passing round the tie-beam, are placed; and this plan may be continued, according to the size of the roof. Queen-posts are sometimes used without a king-post, the heads of the queen-posts being kept apart by means of a piece of timber, called the "straining beam" It is also in some cases found desirable to do without a tie-beam at the bottom of the principals, but to place it higher up, in which position it is called a "collar-beam."

The framing thus constructed is called the "roof truss," and it is clear that such arrangement of timbers need only be placed at intervals to support the whole weight of the covering, and yet the spaces behind the trusses require to be bridged over.

This is accomplished in the following manner: Horizontal timbers are placed across the trusses—at right angles to them; these are either notched on to the principals, or rest against blocks previously attached.

On these purlins the common rafters are placed, as already described in relation to the "lean-to." They abut at their lower extremity against a timber parallel with the purlins, and resting on the end of the tie-beam beyond the point of insertion of the foot of the principal rafters, or they may be notched on to it, so as to pass on and form the projecting eaves.

Battens, or strips of wood, are nailed at intervals across these, parallel to the purlins, and to these the slates are nailed; or, if the

roof is to be an open one—that is, if it is to be visible inside the building—the purlins are boarded over, instead of battened, the slates being nailed to the boards. The whole of the roof-timbers may then be oiled and varnished, and a very beautiful appearance is thus presented. Those gentlemen who are interested in the subject, will do well to read Brandon's "Timber Roofs," in which are some illustrations of the finest specimens in the country.

"Camber beams" are horizontal pieces of timber made sloping from the middle on the upper side, towards each end in an obtuse angle, for discharging the water.

"Auxiliary rafters" are pieces of timber framed in the same vertical plane with the principal rafters, under and parallel to them, for giving additional support when the extent of the building requires their introduction. They are sometimes called "principal braces," and sometimes "cushion rafters."

"Joggles" are joints formed by the meeting of the struts with king-posts, queen-posts, or principal rafters; or at the meeting of the principal rafters with the king and queen-posts: the joint should be at right angles to the strut; and where the line of the rafter is not at right angles to that of the strut, the end of the latter should be so cut, and the mortise in the principal should be made accordingly.

The particular manner of fixing the tie-beam to the wall plate is called "cocking" or "cogging." One method is by dovetailing; the other by notching the under side of the tie-beam, and cutting the wall plate in a corresponding form.

The "Ridge-tree" is a piece of timber fixed in the vertex of a roof where the common rafters meet. It is supported by the trusses, and should rest in a recess cut for it in the top of the king-post.

The amateur house carpenter will be most likely to buy his timber of the proper length, but the means of purchasing what we want does not by any means imply that the article we require can at all times be

procured; and a knowledge of one or two methods by which timber may be lengthened cannot but prove of service.

It must be understood that in joining two pieces of timber, the great object to be borne in mind is that the parts must be weakened as little as possible, and therefore the less timber cut away the better. Under these circumstances, if one piece of timber were placed over the other, and the two firmly bound together, the joint would be the strongest that could be made, were it not that for horizontal purposes the whole safety would depend on the strength of the substance by which the pieces were united, and thus, when that decayed or wore out, the pieces would separate; whilst, for vertical purposes, the weight would be sure to cause the upper piece to slip downward The pieces must, therefore, be bolted together; but then the entire weight is borne by the bolts; by this system, too, the continuity of the line is lost.

The plan often adopted is that termed "fishing the joint." This system, Fig. 81, consists in placing the pieces which are to be joined end to end, and clasping them between two similar pieces—bolts running through all three pieces. This joint, like the former, is improved by cutting saw-like ridges in the outer pieces to fit in corresponding grooves in the two pieces to be joined—by which the danger of their slipping over each other may be prevented. It will, of course, be seen that by both these methods the width of the beams is increased, and their appearance is rendered clumsy.

It must be borne in mind that the strength of material must be counted from its weakest part; for if a piece of timber of 9″ thickness be sawn half-way through at any one part, the general strength must not be calculated at what the thickness of 9″ timber would bear, but at 4½″, for it would break at the sawn part; and therefore, the moment we begin to cut any portion of the wood away, we weaken it in proportion.

The next plan is that called "halving," which has already been mentioned. The wood here retains just half its strength, but this may be

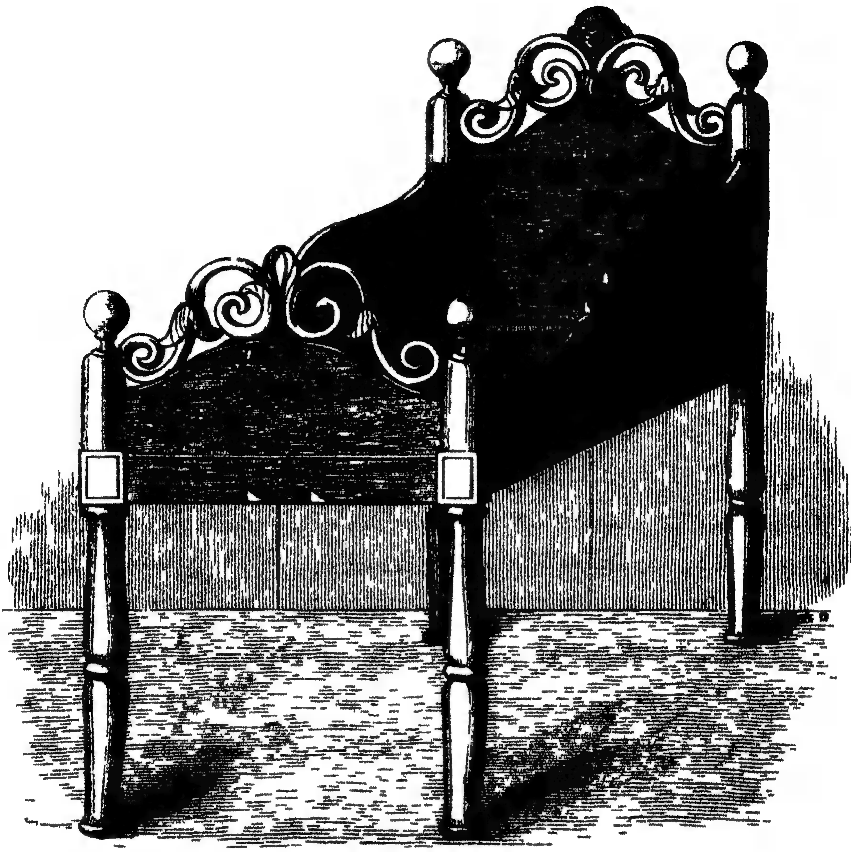
much increased by "coupling boxes:" *i.e.*, square rings of iron be forced over each joint, and bolts be passed through the part between them. This joint is specially useful when employed vertically; and it must be pointed out that when timbers are to be lengthened horizontally, the joint should be situated over an upright support, the bearing of which should be extended by means of a horizontal piece extending under the whole of the joint (Fig. 82).

Another very useful joint is that shown in Fig. 83, which, although it possesses for horizontal purposes little more than one-third of the full strength of the timber, is still very well adapted for columns and uprights, as the "sally" cut at the ends prevents it bending. The separate parts are shown in Figs. 84*a* and *b*.

Fig. 85 is an example of oblique scarfing. Both pieces are cut obliquely, each ending in a sally, as in the last figure; a square hole is cut in the middle, into which a key is driven. This causes the parts to reach closely "home," but care must be taken that too much force is not used, so as to produce constant internal strain of the parts.

Fig. 86 is the French method of making this joint—called by them "*Trait de Jupiter.*" It differs from the foregoing only in the fact that the key is placed at right angles to the line of junction. The object supposed to be attained is that, whilst in Fig. 86 there is a chance, when the key is driven in, of the triangular piece at A being split off, which is not likely to occur in this system; but it seems clear that as the key, when driven in, forces the parts away from the centre and drives them outward, there is here every chance of the protecting ridges at *b* and *b* being forced off. Both of these methods are frequently worked with several keys. It will be seen that however well united the joint can only possess half the strength of the original timber.

Fig. 87 shows the rectangular method of scarfing—adapted either for vertical or horizontal purposes. It is often worked with several keys; but it will be seen that the wood only retains one-third of its



BABY'S CRIB.

(Fig. 88.)

It cannot be denied that many of the babies introduced into this sublunary world of ours, in former years, grew up to be great men and women. We have heard of a lady who asked the curator of a museum, if he possessed "the skull of Oliver Cromwell when he was a boy," assuring him that no museum was worthy the name which was not thus fortunate, and to speak of Socrates when he was a baby seems equally sacrilegious. Yet, when one comes to think of it, we cannot help asking ourselves whether Plato, Socrates, or Aristotle had their brains well shaken up several times a day when they were babies? It seem strange, too, that the human mother is the

only one bearing that name who has ever thought that a child's rest is best promoted by disturbing it; and that the way to cause a child to fall into the gentle slumber, into balmy sleep, is to put it into a box made of wood, or a wicker cage with a hood—like the cabriolets of old—the machine supported on rockers, which the nurse or mother keeps on treading whilst they work, until the child—tossed upon the waves of adversity even in those early days—is often literally jerked about until nature gives way, and the poor victim loses consciousness, and falls—or rather is thrown—off to sleep in spite of the disturbing influences.

That this is wrong is shown by the example Nature sets us; for all other young animals curl themselves up in their nests, or fold their head beneath their wings, and sink to sleep. Why then should we have cradles? If the child is in health, it must go to sleep at the proper time, and if not, there are *causes* which must be removed by means other than shaking; and so, happily, we find cradles only at very antiquated furniture brokers'; and even the modern translation of them, swinging cots, are falling into disuetude, the trim crib gradually taking their place. And so we will make a Crib, the design being one carried out by the writer in his own home, and which served its purpose well for the first ten years of the life of one of his dearest treasures.

The wood best adapted for the purpose is good clean birch, which may be obtained very prettily veined, and when subsequently French polished, the crib really becomes a very handsome article of furniture, well repaying the labour bestowed upon it.

As will be seen from the sketches, the structure—the design of which is given in Fig. 88—is supported on four legs, which may, of course, be varied according to taste, so long as the block is kept perfectly rectangular, and the height of the blocks in all the four legs is equal.

These posts must be turned; and if this is a little out of the way

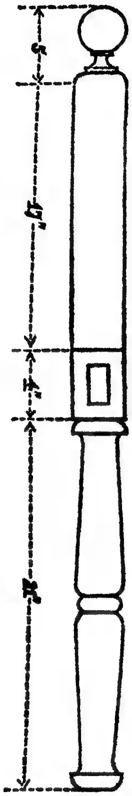


Fig. 89.

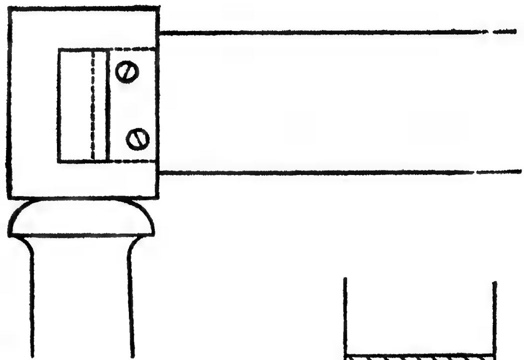
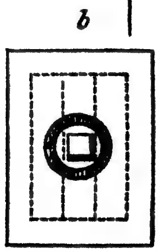


Fig. 92.



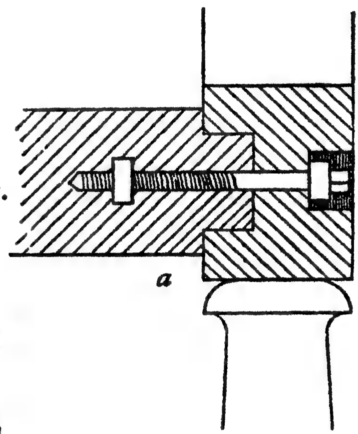


Fig. 91.

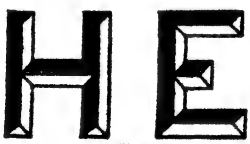


Fig. 93.

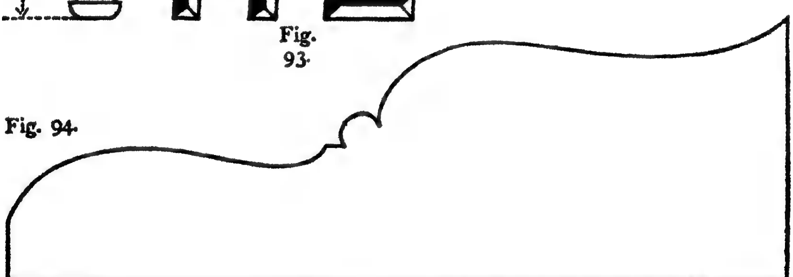


Fig. 94.

Fig. 90.

of the amateur carpenter, he can get them done out of the house for a small sum, and he has still his work to do to them afterwards. The measurements are given in Fig. 89.

In the first place, a mortise 2″ × 1″ and 1″ deep, is to be cut on the

one side of the rectangular block of each of the posts; for the insertion of the tenon of the side-pieces, another mortise of the same size, but ¼" deeper, is to be sunk on the side at right angles to the one referred to, in which the tenon of the end horizontals to be subsequently described, are to be placed.

The horizontals for the sides (Fig. 90) are to be made of wood 3" deep, 2" wide, and 4' 0" in the clear, 1" extra being allowed at each end for the tenons: these are to be 1" thick and 2" broad, the wood being reduced by ½" all round. Find the centre of the face of the block in the posts opposite to that at which the tenon of the side horizontal enters, and at this point cut a circular recess 1" deep and 1¼" diameter; which will, of course, be done with the brace and bit. This should for awhile be used with but very little force, so that the edge of the cut may be smooth and clear, and the force should also be diminished gradually when near the bottom, so that a flat surface may be left. A hole ⅜" in diameter is now to be carried through from the centre to the other side, that is, into the centre of the bottom of the mortise; this will be best done with an auger.

The tenon must now be inserted into the mortise, and the side-piece must be held by an assistant, so that it may be kept perfectly at right angles with the post, and the shoulder close to the block. The auger is then to be again placed in the hole, and driven into the tenon for a short distance. The parts may then be separated, and the hole in the side-piece continued until it is quite 4" deep, measuring from the shoulder. It will at once be seen that the bed-screw to be used must be one 6" long and ⅜" thick.

It will be evident that if the screw were now inserted, the fibres of the wood would give way as the screw was tightened up; that the "thread" which the *iron* screw would make in the *wood* would soon give way, and the crib would thus become shaky. This is prevented by the following arrangement: With the screws "nuts" are

sold. These are square pieces of iron pierced by a hole, the thread of which corresponds with that of the screw, and into these the screw is made to work. Draw two lines on the inner side of the horizontal exactly over the long passage bored for the screw, and at 3″ from the shoulder cut a cavity at right angles to these two lines, and precisely the shape of the edge of the "nut." This cavity must be sufficiently deep to allow the nut to sink in it until the hole in the nut corresponds with that in the wood. The screw will then work in the nut, and will thus, when turned by the bed-winch, draw the two parts closely together. The hole in the side is to be filled up by gluing a piece of wood into it.

If now this part, when screwed up, were cut through and the wood on the one side were removed, the view obtained would be that given in Fig. 91 *a*, which is called a "vertical section," whilst the end view is given at *b*.

The lower edge of the horizontal is now to be shaped. The form having been drawn on the side, and the wood having been tightly screwed up in the bench-vice, the angle is to be worked away with the drawing-knife, the extreme angles at which the curves meet (*a* and *b*) having been cut down to with the tenon saw, the drawing-knife being worked towards these saw-cuts; the work is, of course, completed with the spokeshave, the blade being set very close to the handle, so that only very thin shavings may be taken off, and the curves may be graceful and clean. The pattern should be cut in cardboard, and this templet should be laid on the wood to guide the pencil, and as this will also be used on the other side, the exact similarity will be insured.

Recesses, 3″ long and ¾″ deep, are to be cut at distances of about 4″ from each other, on the upper and inner edge of these horizontals; and in these the cross-pieces for the support of the bedding will subsequently be placed.

The horizontals for the shorter sides are now to be proceeded with. They are to be of the same width and thickness as the longer sides, and are to be 2′ 0″ long from shoulder to shoulder, with a tenon 1¼″ long at each end. These shorter horizontals are not to be attached by bed-screws, but the tenons, having been inserted in their mortises, two screws 2½″ long are to be driven in from the adjacent side of the block; these screws must not, however, be placed in the same vertical line, but in the manner shown in Fig. 92.

The head and foot-boards are to be made of wood ¾″ thick. They are to be 2′ 2″ across, of which width, however, 1″ on each side will be inserted into corresponding grooves—or rather long mortises—cut in the cylindrical portion of the posts immediately over the mortises in the blocks. In cutting these mortises great care must be exercised to avoid damaging the turned posts, and some soft body, such as a pad made of a piece of cloth folded up, must be laid under the rounded part during the operation. The mortise is to be 9″ long, measuring from the top of the block. Similar mortises are to be cut in the shorter posts at the foot of the bed, which must, however, be only 6″ long from the blocks. Corresponding tenons, the full width of the boards, must be left on each side.

And now the head and foot-boards are to be taken in hand. These may, of course, be merely straight boards of any convenient height, or they may rise towards the middle by a straight or curved line, or, in addition to the mere form of the board, they may be surmounted by sawn and carved ornaments, as suggested by the sketch.

The form of the top of the board having been decided upon, and the scroll having been designed on a piece of cardboard, it should be cut out, and having been marked in pencil on the one side of the central line, the pattern is to be reversed, and the other side drawn; and as, in working, the pencil-lines are liable to become erased, the

drawing should be repeated with ink, for which work a quill pen will be found the most convenient.

The system of designing work which has to be sawn has already been described in relation to the panels for the pavilion; it is only, therefore, necessary to remind the amateur that the pattern should be so arranged that one part may give support to the other, not only when finished, but also whilst *sawing*—during which operation a sudden jerk, caused by disengaging the saw, is very liable to break off ends of scrolls, &c.

For external curves and large "sweeps," a blade of about ¼" wide may be used in the saw; a much narrower one being employed in smaller curves and turnings.

The board should be held in the bench-vice in an upright position, so that the saw may be used with both hands in order to guide it the more accurately: the hands should grasp the handle and the lower part of the frame, the latter being turned out of the way, when it prevents the saw entering farther into the edge of the board. As previously remarked, the greatest care must be taken to prevent the saw becoming twisted, as in that condition it will assuredly snap; and it cannot be too often impressed on the mind of the worker, that the direction of the saw must be carefully watched, so that the edges sawn may be at right angles to the surface of the board. The back of the sawn work should, in fact, be precisely like the front.

The design is now to be finished by carving; and a few hints on this delightful art will therefore not be unacceptable.

The chisels and gouges used for carving are not quite the same as those used in carpentering—they are, in fact, called "carving tools"—and should be kept for work such as the present. They are ground differently from those generally used; for, whilst the carpenter's chisel is bevelled on one side only, these are gradually thinned on both sides, by which a cleaner, or, as carvers say, a "sweeter" cut is

obtained, and the depth to which the tool is to sink in the wood is better regulated. The gouges, too, should be ground much more on their inner side by means of the "Turkey slips," than for carpenters' use.

Several of the chisels, in addition to this method of grinding their faces, should have their cutting edge at an angle with their long edges, by which the carver is enabled to work more accurately into interior angles and curves than he could do with a chisel, the edges of which are at right angles with each other.

For small carving and for very refined work, miniature chisels and gouges are sold under the name of "print-cutters' tools," a few of which will be found very useful to the amateur. Besides chisels and gouges of various sizes, there are "bent tools" both of the chisel and gouge forms: these are very convenient in carving on parts of the design where a straight tool could not reach, or in following the internal sweep of a curve. Others, again, are called "parting tools," which are gouges formed of two surfaces, at angles to each other, the edge being sharp; these, which may be had straight or bent, are exceedingly useful in cutting the outlines and in marking deep veining, &c. There are also chisels which, after bending in a curve, proceed in a straight line, by which the ground under carved work may be cut. There are, in fact, numerous varieties of carving tools, not a twentieth of which will be required by those for whom these pages are written, and for whom a couple of chisels, a couple of gouges, and a couple of print-cutter's tools (small chisels), and a single bent tool, will suffice for present purposes.

It is by far the better plan to supply the necessity for additional tools as it arises, than to buy a "good set," containing so many and of such various forms, that the amateur is puzzled which to use first; and in attempting to manage a complex tool, intended only for expert workmen and for some very peculiar purpose, the work which could

have been fairly done with simple tools is often injured or spoilt altogether.

In commencing to carve the design on the head-board, the stalks must be separated from the husks by lowering the latter in a very slight degree, the edges of the work being rounded off. Such indentations and veinings as may be required on the surface must then be made, care being taken that the general outline is well preserved; and in this portion of the work various curved files will be found of great use.

The foot-board is to be worked in the same way, but in this the work must be well finished on both sides, since the back, as well as the front, is constantly in view.

The chisel must, as far as possible, be worked in the direction of the fibres of the wood—a matter in which experience will be the best guide; but where this cannot be done, the main portion of the wood should be removed by the gouge, the work being finished with the chisels and bent tools.

The upper portion of the head-board is formed by a small tablet, on which an opening rose-bud—emblematic of childhood—is carved.

Having carefully drawn the general form of the flower and leaves, the outline is to be "stabbed out," that is, it is to be cut by pressing the small chisel about $\frac{1}{16}''$ downward—sinking the drawing, in fact. The form is then to be cleared by cutting the wood away around it, thus forming a groove slanting towards the pattern; when this is done, the whole ground may be cleared up to the outline of the scrolls. This process is to be repeated until the highest parts of the design are in sufficient relief; at the same time the general levels of the different parts must be attended to: for instance, some portions of the stalks or leaves may be lower than others, and this effect should be at once indicated and carried on throughout the different stages, so that the idea and intention of the design may be kept in view from beginning to end of the work.

A diaper pattern may be formed on the ground by simply indenting with the brad-awl, on which rapid blows are to be struck with a small mallet, turning the tool about in various ways.

The beautiful sentence from the Psalms, "For He shall give His angels charge concerning thee," will not, we are sure, be omitted by the amateur. The work may be increased; but whether the worker be father, brother, or friend, it is a labour of love: and is there not the hope that when the loved occupant of the little bed traces over the letters with its rosy fingers, and asks what they mean, the first ideas of the merciful protection which, whether awake or asleep, ever hovers over it, may be aroused? Who knows, whether in sickness they may not give comfort during hours of wakefulness and suffering? —for our children think and feel deeply, more deeply, perhaps, than we ever give them credit for: thoughts and feelings may thus be awakened, the influence of which who can tell?

The letters, having been carefully traced out, are to be incised by a simple slanting cut, so that their sides may meet at an angle at the bottom of each letter; of course, in the curved letters, this will require some care. The effect will, perhaps, be best understood from a couple of letters given in Fig. 93.

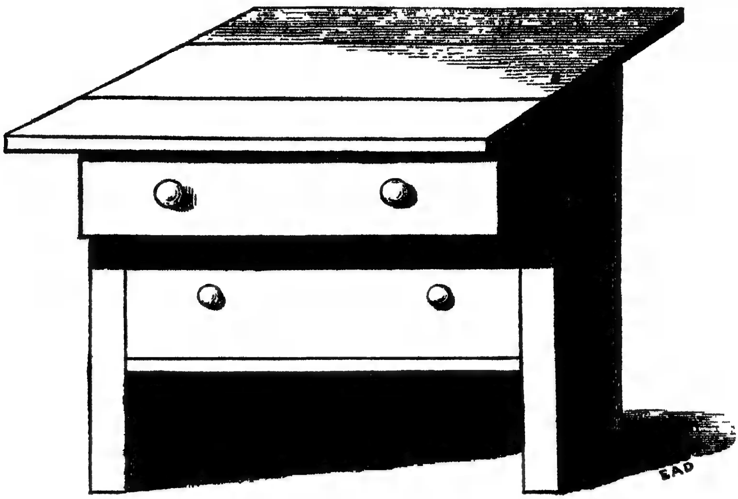
The sides, illustrated in Fig. 94, are to be made of ¾" wood; their length, must, of course, be such that they may fit exactly between the posts; the height and precise form are matters of taste. The child must be protected against falling out of the crib, but it is not to be enclosed by walls, which shut out the view of all surrounding objects from its observant eyes, and therefore the boards should not be too high.

These sides are not to be mortised into the posts like the head and foot-boards, as it may be desired to remove them occasionally: they are, therefore, fastened by means of "flush bolts," which are sunk into the inner surface. But some young people's powers of observation

may be greater than others, and, having seen Nurse remove the sides by moving the bolt, they might possibly try the effect of similar exertions on their part, the result of which must be prevented by fixing into the lower edge of the boards three iron pins, of ¼″ or ⅜″ diameter, protruding to the length of 1″, and corresponding holes being bored in the tops of the horizontals, the side requires to be lifted vertically as well as horizontally—a joint operation of which we do not think our juvenile friends capable.

The several parts having been thus completed, the ends are to be put together first; the side horizontals are next to be placed; then the cross-pieces; and, finally, the sides.

The whole may be French polished, or oil rubbed, according to taste; and small castors should be screwed into the bottom of the feet.



NURSERY DRAWERS AND TABLE.
Fig. 95.)

Our readers will, ere this, have discovered that our sympathies with the denizens of the nursery are many and deep, and these are never more strongly appealed to than when we see children disturbed in their play. The nursery is, we know, the place where they are to be dressed, where they are to take several of their meals, and where, possibly, they are to be taught; but, as it is the place where very much of their time is to be spent, it is their indoor playground as well, and special arrangements should be made in this respect.

How often do we see the table cleared just at the moment when the hopes of the hard-working young builders have reached the very climax, so that the cloth may be laid for dinner, or that some fabric, about to be shaped into a pelisse for Baby, may be spread out. Our youngster, of course, may be told to "bear it like a man," but he must "feel it like a man," also; and either the cords which confine the lachrymal sac, or those which confine his temper, give way,—he cries,

or he is "naughty:" in either case his good humour is gone, for a time at least.

We purpose, therefore, to give the method of constructing a Nursery Table, and the following are to be the advantages it is to afford its possessor: 1st, That it will take up as little room as possible when not in use, but that the size may be doubled when required; 2nd, that it will contain two capacious drawers in which the toys, &c., may be placed when not wanted; and, 3rd, that its lower storey forms a stable and coach-house for the Pickford's vans and dray horses, by means of which goods are conveyed over the entire range of country embraced within the limits of the nursery floor, and sometimes even extending to the vast wilderness of the landing outside.

The table, Fig. 95, consists in the first place of four legs, 2″ square and 26″ high, and, of these, the two which are to support the back must be grooved on two adjoining sides; the grooves are to be situated at ¼″ from the outer faces, and are all to be ¼″ broad and 1″ deep.

The board which is to form the back must be glued up to the height of 25″, for it is to be placed horizontally, and the width across is to be 22″ from shoulder to shoulder, with the addition of a tenon, 1′ broad, at each end. These boards should be ½″ thick and should be ploughed and tongued together; the tenon is to be ¼″ thick, so that ⅛″ of the wood must be rebated on each side. As the thickness of the legs is 2″, the total width of the back when they are added will be 28″.

The total width of the sides is to be 14″, and as, of this width, 2″ on each side will be taken up by the thickness of the legs, the breadth of the boards from shoulder to shoulder, must be 10″, with, of course, the addition of a tenon of the width of 1″ at each end. If, now, the parts thus prepared were put together—the back and sides—three walls at right angles to each other would be formed. Before this is,

however done, grooves ½″ deep must be cut in the sides of the two front legs, at right angles to the front, to admit of horizontal pieces being placed in them for the drawers to slide on: these pieces should follow the shape of the internal angle, so that they may be secured by nails driven from the sides of the casing and also by a screw or two passing from their back edge into the legs. Into the middle of

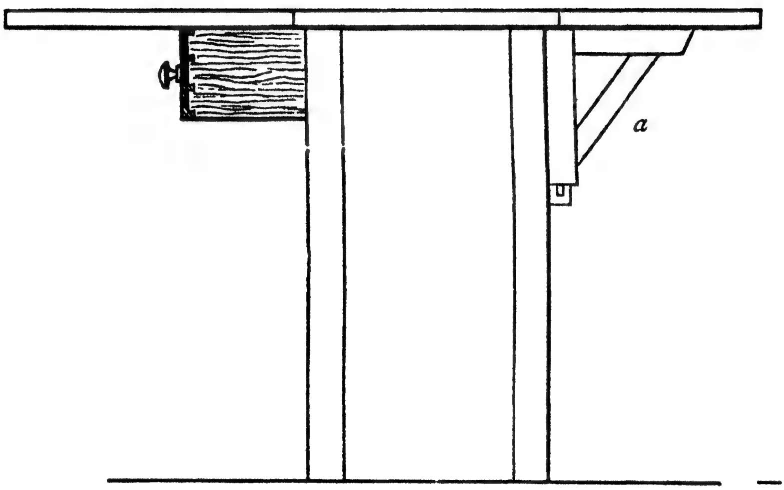


Fig. 96.

these, cross-pieces are to be mortised—the opposite ends to rest on small blocks at the back—to give support to the drawers as they move inward or outward.

The following are to be the heights of the front horizontals, which are to be 1″ thick, the lower one 8″ from the bottom, the second one 19″. The ground floor, *i.e.*, the space under the lower drawer, will thus be the stable or coach-house, enclosed on three sides, the roof being formed by the lower drawer, which will fill the second compartment, whilst the second drawer will fill the space above, the top being formed by the fixed slab of the table; and, as the top edge of the drawer will work directly against this, it will be kept perfectly firm

and horizontal, without the power of sinking forward when open—an advantage which will be referred to presently (Fig. 96).

The method of making the Drawers has already been explained in relation to the wardrobe and table; it will, therefore, not be necessary to repeat it here. The materials used should be as light as is consistent with strength; the front should therefore be ¾" wood, the sides ⅜", and the bottom ¼". The top is to be 14½" wide and 27" long: it is to be so fixed as to project ½" on each side and in the front, but not at all at the back. It may be fastened in one of the methods already shown.

This top, however, is to be a double one, so that the available surface may be enlarged; thus a second board of precisely the same size as the original top is to be prepared, and this is to be attached by hinges to the other one. These hinges may be obtained at any ironmonger's: they differ from box hinges, as they are adapted for fixing on the *edges* of wood. By their adoption the surface of the table, when the additional leaf is opened, remains quite flat, without the back of the hinges projecting, and as they are longer than could be used on the front edge, where they would be limited by the thickness of the wood, and where they would injure the appearance, they are very much to be preferred.

Before unfolding the additional leaf of the top, the upper drawer must be opened rather more than half-way, and as this (as already mentioned) works closely against the top, it will be kept perfectly horizontal, thus affording an excellent support for the leaf, and still leaving room for the child to sit comfortably at the table. Small castors screwed into the feet are not indispensable, but will save the carpet if the table is moved about frequently.

Handles to the drawers will, of course, be required, and locks will add very much to the value of the piece of furniture in the eyes of the young folks for whom it is intended. In this case, duplicate keys

should be kept in possession of Nurse, *in case* the holder of the one in general use should, at any time, mislay it.

The size of the table may be still further enlarged by a leaf at the back, made to hang down. When required, it is to be raised and the bracket turned forward to support it (Fig. 96*a*): this bracket is to be made of wood 1½″ wide and ¾″ thick: it rotates on two iron pins—the one inserted into a hole in the under-side of the edge of the top of the table, which must in such case be made to project, and the lower one working in a piece of wood, 1″ thick, screwed on to the back.

Fig. 97.

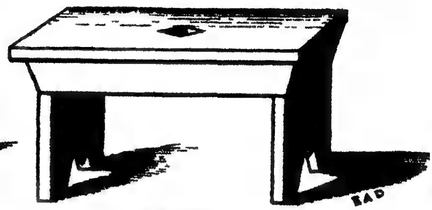


Fig. 98.

A NURSERY CHAIR.

Having thus described the method of making a piece of furniture at which the child may sit and play, we now proceed to furnish information as to the important appendage—a Chair (Fig. 97). Our instructions will necessarily be brief, as many of the processes of construction which will be alluded to have already been explained.

The chair is, in fact, a small table: two of the legs of which seem to have taken a start and grown up beyond the surface, requiring only to be connected at the top. The sizes here given are such as will correspond with those of the drawers, but, as often stated, these may be varied to suit the wishes of those concerned.

Of course, the lighter the chair the better—so that it may be lifted by the children—but, at the same time, it must be strong, and although ledges connecting the legs add to the weight, they increase the strength so much that it is advisable to add them. Children do not carry a chair by the back as grown folks do; they clutch hold of the whole mass, so that, instead of the lower legs touching the ground first, the chair usually comes down with its full weight on the extremity of one of the front legs, which, if attached only by the

tenon at the top, is apt to break off; and then, if there should not happen to be a resident "Amateur House-Carpenter," to repair the chair, it is thrown aside in some lumber-room as one of the things which, when asked for, are found to have been "broken long ago." The ledges, by giving support to the lower portions of the legs, avert this, and the value of the chair is consequently much increased. The ledge or rail in the front answers the additional purpose of supporting the feet of the child if they do not reach the ground, and it is thus made more comfortable than if its little extremities were hanging down.

The seat of the chair should not be too broad, and the back should be as straight as possible, so that the child may not loll in a slovenly or "doubled up" fashion, but that the spine may be well supported by the back of the chair. Any one who carefully watches children will observe how much more lively they are when sitting up straight, than when they are allowed to hang their heads over their inwardly-curved chests; and as this is often the result of sitting on stools or seats without backs, the present few words are intruded on the reader under the assumption that he is interested in the comfort and health of those for whom he is working.

A miniature kitchen chair, then, would, to all intents and purposes, be the best that could be adopted; but everything that is ugly should, as far as possible, be excluded from the nursery; and therefore, although the general principles will be retained, we hope to show how the appearance of the chair may be materially improved, and its resemblance to those over which dogs are taught to jump, and on which clowns climb in a circus, may be in a great degree removed.

The wood may be birch, or pine, French polished, stained and varnished, or painted: that used for the legs and back is to be 1½" square, and these are to be of the following lengths: the two front legs 11½", the back legs 26".

There will be several mortises in these, and we will take the back

in hand first, and cut the mortises into which the horizontals, which are to unite the two uprights, are to be placed. The heights of the rails themselves are given, with the understanding that the mortises are to be somewhat higher, as the tenon will be rather smaller than the cross-pieces, in order to allow of a shoulder.

The back then assumes the form of a ladder, the first rail, which is to be 2″ wide, being placed at 5″ from the ground. All the cross-pieces are to be made of wood ⅜″ thick; the mortises will therefore be somewhat narrower.

The seat of the chair is to be made of ½″ wood; the top of the uppermost rail—that is, the piece of framing on which the seat is to rest—must be flush with the top of the front legs, and will therefore be 11½″ from the bottom of the back, and the mortise must be cut at ½″ below this. The width of the framing is 2½″, the tenon 1½″, leaving a shoulder of ½″ on each side. The next mortise is for a rail across the middle of the back. This will be situated at 4½″ above the line of the seat, and will be 1″ long, the width of the rail itself being 2″. At 5″ above this, the mortise for the top cross-piece is to be cut; it will be 2″ long, the cross-piece being 3″ wide.

And now, assuming the back to be put temporarily together, we proceed to indicate the places for the mortises for the side framing and rail, and may at the same time explain that the heights of these will also give those of the mortises in the inner side of the front, into which the opposite tenons of the side-pieces are to be inserted. The mortise for the top rail, or side-piece of the framing, which is to be 2½′ broad, will, of course, be on a level with that of the piece connecting the two parts of the back, whilst the lower rail, which is to be 1½″ broad, will be 3″ from the ground. The upper piece of framing in the front is to be 3″ broad, and the lower one, which is to be 2″ broad, is to be at 5″ from the bottom. It only now remains to add that, as the seat of the chair is to be, as it were, carved out of a cube or block 12″

in every way, this will be the width of the sides; and as of this width $1\frac{1}{2}''$ is taken up on each side, the length of the rails and framing from shoulder to shoulder must be 9″, exclusive, of course, of the tenons, which should be at least $\frac{3}{4}''$ at the end. This length must, however, only be considered as constant in relation to the four pieces forming the framing and those crossing the back, for reasons which will be seen presently.

It has been said that, wherever possible, grace and beauty should be given to everything in the nursery, and the general form and dimensions being now understood, the amateur will at once see that the chair need not remain the stiff straight structure which it would become if put together in the present condition of the various pieces.

The legs and back may be turned, to correspond with the posts of the crib, or in any other design which may be wished—the blocks only into which the framing is inserted being left square; or, with very little trouble they may be shaped in the manner suggested in the sketch. This may be done with the drawing-knife and spokeshave, the pieces being held in the bench-vice. Very much grace may thus be given to the lines; but care must be taken that the curves are not exaggerated or sudden. It must be borne in mind that gentle curves are infinitely more graceful than deeper ones; hence in architecture elliptical curves are so much more admired than arcs of circles, an æsthetic beauty, which is a distinctive feature between the Grecian and the Roman mouldings.

The breadth (which it is not desirable to exceed) of the pieces of wood of which the framing and rails are to be made, have been given; but these are not intended to remain straight. The use of the turning-saw and the carving chisel have been explained in a preceding article; and these may now well be called into play, the shapes into which it is desired to saw these pieces having been first cut in cardboard, in order that their effect may be tried before the work is

actually begun, and bearing in mind that each part of the ornament must support the other, so that the beauty may not be purchased at the expense of strength. The inner sides of the legs and back will now curve slightly outward, and the lower rails will thus require to be slightly longer than the framing. The chair should therefore be put temporarily together, so that the exact length of these may be measured.

A shield, with the crest of the family, forms a pretty central ornament in the upper cross-piece of the back; or a wreath, enclosing the initial of the little one for whom the chair is intended, as marking the individuality of the gift, will always be a source of great satisfaction to the possessor. This initial may either be carved in relief, or it may be sunk, and the letters, cut out of veneer of another colour, may be accurately fitted in and glued. Simple ornamental patterns may be inlaid in this way on the sides of the legs and back, and a border around the seat may be formed; even if it be only a line, it will relieve the monotony of the surface; but it must be very clearly understood that no carving on the seat is admissible, nor any ornamentation which indicates relief, or in any way interferes with the feeling that the seat is a flat surface, and that any projecting ornaments would interfere with its purpose.

The seat is to be made of wood ½″ thick, and must project ½″ all round, pieces being of course cut out to admit the uprights of the back. The corners and edges must be nicely rounded, and a "thousand and one" little things done which are dictated by good taste, but which it is needless to describe here. Blocks are to be screwed against the inside of the framing, and through these, screws are to pass for the attachment of the seat. The extreme edges of the feet should be just taken off with the spokeshave.

A stool (Fig. 98) is added in the sketch, but the construction is so simple that it is assumed that the amateur carpenter will not need instruction on the subject.

VENTILATORS FOR DOORS AND WINDOWS.

It is our desire that this should be an absolutely practical book; but, strange as it may seem, this is precisely the reason why a certain amount of theory must be introduced—for if the work be done, no matter how well, but the purpose be not achieved, the energies of the worker are thrown away, and his time wasted. Labour can only be well bestowed when the principles of the work to be accomplished are understood, and practice thus becomes the embodiment of theory.

The following extract from an admirable article on the subject is quoted from "Chambers's Encyclopædia:"

"The necessity of constantly renewing the air wherever living beings are breathing arises chiefly from the effects produced upon air in the lungs. The average quantity of carbonic acid in expired air or breath is found to be 4·3 by measure. Now, this gas when taken into the lungs is a poison, and tends to arrest the vital processes. Like other poisons, however, it can be rendered harmless by dilution.

"The small proportion naturally existing in the atmosphere is perfectly innoçuous, and may be considerably increased without sensible effect. But it is decidedly prejudicial to breathe for a long time air containing one measure in 100 of carbonic acid, and it is considered desirable that the proportion should never exceed 1 in 500.

"We may assume, then, what is near the truth, that 20 cubic feet of air pass through the lungs of a man in an hour. To reduce the poison of this to 1 per cent., at which point it is barely respirable, it requires to mingle with as much fresh air as will make a mixture of nearly 100 cubic feet, and to make the dilution all safe, it must be carred five times as far; in other words, the respiration of one human being vitiates hourly about 500 cubic feet of air.

"In addition to carbonic acid, expired air contains an undue amount of watery vapour. Minute quantities of animal matters are also exhaled with the breath, which in close, ill-ventilated apartments, form a clammy deposit on the furniture and walls, and by putrefying become organic poisons.

"A further necessity for the constant renewal of fresh air arises wherever lights are burned. The deteriorated air of a fire goes off by the flue, but lights are generally burned where the products must mingle with the atmosphere of the apartment. Now, 1 lb. of oil in burning consumes the oxygen of 13 feet of air, and produces a large amount of water in vapour, and also of carbonic acid. Every cubic foot of gas consumes the oxygen of 10 feet of air, and forms at least 1 foot of carbonic acid, besides watery vapour, sometimes mixed with sulphuric fumes.

"To counteract these various sources of pollution, and keep the air sufficiently fresh and wholesome in rooms where many persons are breathing, it is found in practice that on an average about 20 cubic feet of fresh air per minute for each individual must be supplied.

"Ventilation consists of two operations: 1. The removal of the foul air; and, 2. The introduction of fresh. Though neither operation can go on without the other going on at the same time, it is convenient to consider the two separately.

"The agents employed in removing the air from apartments are chiefly two: that by which Nature effects the ventilation of the earth on a grand scale, viz., the draught of ascending currents, produced by the difference of temperature; and mechanical force, such as pumping. The former is the most common, and is the only one applicable to private houses.

"The column of air in the chimney of a lighted fireplace being expanded and comparatively light, exerts less than the prevailing pressure on the air immediately under and about its base; the air, therefore,

below and around it pushes it up, and flows in to take its place, the velocity of the movement being in proportion to the height of the chimney and the degree of heat. Thus, although it is often convenient to speak of the air being *drawn* or *sucked* into the chimney, the force does not lie in the chimney, but in the greater measure of the air behind.

"Wherever, then, there is a heated chimney, there is a means of removing the foul air, and in rooms moderately lofty and spacious, and windows and other fittings not closer than usual, and a chimney-mouth of the usual width, there is little risk, when there are only a few inmates, of any serious vitiation of the air. The heated breath that ascends to the ceiling has time to diffuse itself gradually, and be drawn in a diluted state into the currents that are setting from all quarters towards the chimney. These currents, however, are one great objection to this mode of ventilation, as they consist in great part of cold air that has just entered by the doors, and are stronger where the inmates sit to enjoy the fire.

"The ascent of foul air to the top of the room dictates its exit in that direction rather than low down at the mouth of the chimney. It is conceived by some that the carbonic acid of the breath, from its greater weight, must be chiefly at the bottom of the room; but this is a mistake: the heated breath ascends instantly, because it is as a whole lighter than the air around it, and the carbonic acid in it does not tend to separate from it and fall down by its superior weight, but, by the law of diffusion of gases, seeks to spread itself equally all over the room, and would do so, though it were lying at first on the floor."

It seems, however, natural to suppose that the fresh air should enter near the ground, so that it may rise, be taken into the lungs of the inmates, dilute the vitiated air, and pass out near the top of the room.

Now, there are certain difficulties in accomplishing this: first, in avoiding direct draughts, and secondly, in arranging that the air

admitted should be in some degree warmed, so as to be equalized in temperature with that of the room before it is mixed with it.

Of course, the first rough idea of ventilation would suggest the admission of air by opening the door and allowing it to pass out at the window; but the draught would be too violent for the purpose, and almost unendurable in anything but a dead calm. Still, by slightly opening the door and drawing the upper sash an inch or two down, a very agreeable current is created when the weather is not too rough.

This, however, is more than some people can bear, and the system, owing to our variable climate, cannot always be adopted; and other plans are therefore adopted, in which the desired ends can be accomplished in such a manner that the ventilation may go on constantly and imperceptibly, and by which the air may be admitted so gradually that it may be said to be warmed during entry.

In the first place, a brick may be taken out, or a hole bored through the external wall, by means of a brick-auger, so that a free passage for the entry of fresh air may be made, and into this a small iron grating is to be placed, or a brick pierced with holes, which may be obtained at any builder's yard; the skirting should then be removed, and a groove or two cut in the bricks, parallel with the floor. These need not be more than an inch deep, just to create a space at the back of the skirting; even scraping away the mortar in the joints to the depth named will be enough. Holes are to be bored in the skirting, which is then to be replaced, and the current will thus be diffused along the whole line of the wall. The holes may be covered at the back with wire gauze or perforated zinc, and thus, as a greater body of air enters the recess than can at once pass into the room, it is kept at the back of the skirting for some time, during which its temperature becomes greatly modified.

In this plan it is, however, assumed that the rooms extend across

the house, as in the case of a back and front drawing-room, opening into each other either by folding doors or an archway, or forming absolutely one room, so that the fresh air can be admitted at one end and pass out at the other; but where there is an external wall on one side only, the opposite one being a middle wall, access for air to the back of the skirting must be obtained from the passage or landing, and the air thus entering will previously have been warmed in passing through the lobby or passage—the fanlight in which should be made to open in the manner which will be presently explained.

No system can, however, be deemed of use in which the ventilation is not under control. And therefore, if the skirting is composed of several boards, the lower one should be separated, and then attached at its upper edge by hinges, so that it may be raised like a horizontal door, being kept open by a small block or two placed behind it, or closed altogether.

Apart from this arrangement, the door, although kept shut, may be made useful in ventilation. It should in the first place be taken down—not such a very troublesome affair, and often done for parties and dances—and about ½″ sawn off the bottom; three or four screws are then to be driven in, so that their heads only project ⅜″ from the edge (Fig. 99). The door may then be restored to its place. Now prepare a piece of wood ½″ thick, exactly the shape of the bottom of the door, corresponding, in fact, in every way with the piece cut off. In this, cut holes exactly the size of the head of the screws, the first hole to be about ½″ nearer the end of the piece of wood than the screw is to the end of the bottom of the door, the rest of the distances to correspond with those of the screws; each hole is then to be furnished with a slot as shown in Fig. 100. Now, let us suppose that the draught is felt by some one, or that for various reasons it is desired to close up the space. Place the piece of wood immediately under the door, slightly raising it by two tiny buttons placed outside, and in

doing so push it towards the hinges; the body of the screw will then enter the slot, and the heads will hold up the piece: the edges of the wood being painted to correspond with the surface of the door, it will not be noticed, and as the air enters so very near the floor, it is scarcely likely to cause annoyance to any one. Where appearance is not so much to be studied, as in school-rooms, bed-rooms, &c. (and in the first of these much of the mental work, and in the second much of the benefit to be derived from repose, depend on the ventilation), holes should be

Fig. 99.

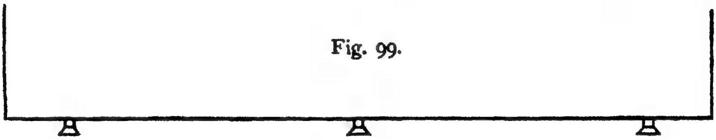


Fig. 100.

Fig. 101.

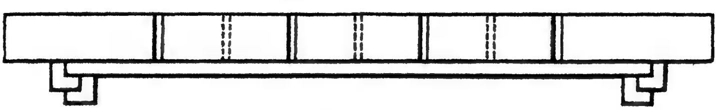


Fig. 102.

bored with the brace and bit through the lower rail of the door; these holes should not, however, be at right angles to the surface, but their direction should be obliquely downwards from the outside, so that there may be no direct draught, but that the air may, as it were, blow first on to the floor, and then turn upward. If desired, a shutter may be made outside the door by which the apertures may be wholly or entirely closed when desired.

Fig. 101 shows a ventilator well adapted for a bed-room in which several children or grown-up persons are to sleep.

This arrangement consists, in the first place, of two ledges, *l l*, screwed

on, at about 18″ from each other, and at about 1″ from the bottom of the door. These ledges are made of wood ½″ thick, the one being ½″ and the other 1″ wide. The pieces being glued at right angles to each other, as shown at *l l*, in Fig. 101, screws 1½″ long will then pass through both.

A number of holes of, say, ¼″ diameter, having been bored in the door between these ledges, a board equal in breadth to the length of ledges, and in length to the distance they are apart, and ½″ thick, is to be prepared, and to this, two ledges, corresponding in every respect to the other two, are to be screwed, so that the steps of these may slide in the rebate of the previous ones, resting at the bottom on a small block, nailed on the door just beneath the rebate of the ledges.

The shutter will then stand at ½″ from the surface of the door, and, the air entering, instead of proceeding directly into the room, will pass upward and downward against the door, and will thus diffuse itself in the room.

This arrangement is also adapted for the door of the nursery; but as the little people, particularly the very little ones, spend much of their time in tumbling about the floor—for which Nature has specially adapted them, their backs, at that period of their lives, being much longer in proportion to their legs than when the frame is fully developed,—a strip of wood must be nailed to the lower ends of the ledges, so as to form a floor to the space behind the shutter, so that the air proceeds upwards, and thus there is no direct draught near the ground.

When it is desired to shut the ventilator altogether, during very wet or windy weather, the shutter need only be taken out and reversed, when the board will slide between the ledges, and the apertures will thus be closed.

Both of these arrangements are shown in plan in Figs. 101 and 102, and a view of the shutter in its place is given in Fig. 103.

We now proceed to show how arrangements may be made for allowing the vitiated air to escape from the top of the room.

One of the best ventilators for this purpose is that invented by Dr. Arnott, and bearing his name, and which is founded on the principle of foul air ascending first to the top of a room. In this ventilator an aperture is cut in the chimney-breast, that is, the wall over the

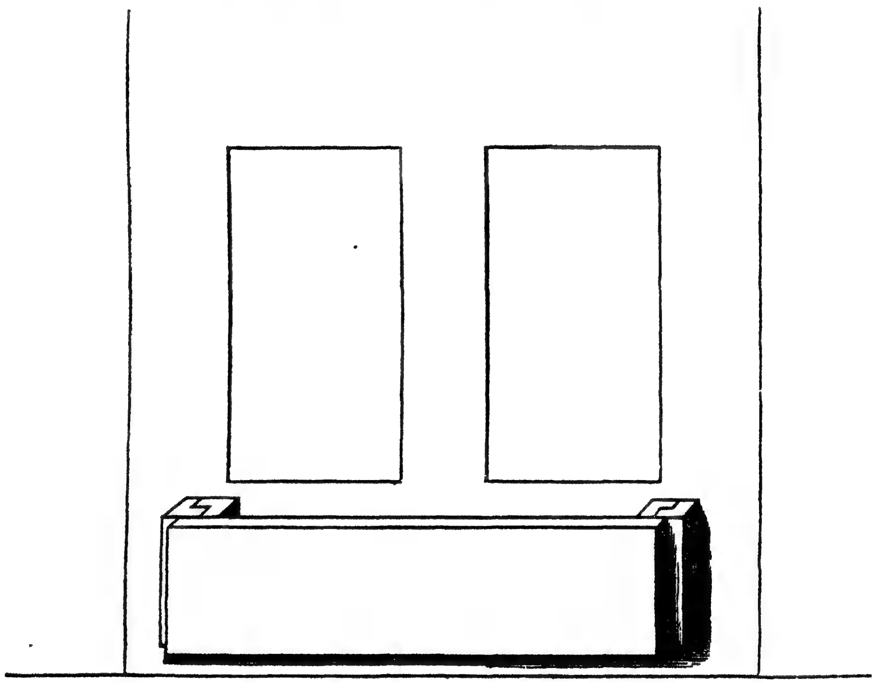


Fig. 103.

mantelpiece, as near the ceiling as possible. In this is suspended a valve capable of opening inward to the chimney, but not in the other direction, by which means a return of smoke is prevented.

The valve is so balanced on its centre of motion that it settles in the closed position, but is easily opened. A flap of 36 square inches is sufficient, where there is a good chimney draught, for a full-sized room with company. This simple apparatus may be painted, or otherwise made ornamental. It operates by virtue of the draught in the chimney.

Whenever that is active from the presence of a fire, the valve is seen to open inwards, and a stream of air from the top of the apartment passes through into the chimney, and is carried off. The operation is precisely equivalent to the stream of air always passing into a chimney between the fire and the mantelpiece, but has the great superiority of drawing off the most impure air in the room. A wire descends to a screw or peg fixed in the wall, by which the opening in the valve may be limited, or wholly prevented.

There are very many ventilators—each one representing special ideas of inventors—for the subject is one which has been much discussed, and on which opinions even at the present moment are much at variance. We must not, therefore, enter further than we have done into the difficult question, believing that there are special features in the construction, and peculiar conditions in the arrangements, of various dwellings, which require the alteration, modification, and adaptation of any system, however correct that system generally may be.

We proceed, then, with our simple task of showing the amateur carpenter how to make arrangements for carrying away the bad air from the top of a room, so that a continual change of atmosphere may take place.

In rooms having central ornaments in the ceiling this is comparatively easy, for the interstices between the plaster scrolls or leaves may be pierced with numerous holes leading into the space between the ceiling and the floor of the room above; a brick or two should then be taken out from the external wall; but the wall will, of course, be more than one brick thick, and therefore through the rest of the thickness holes are to be bored with a good-sized brick-auger. Small iron gratings are then to be placed instead of the removed bricks,—these, made in very handsome ornamental forms, may be purchased. Apertures may also be cut in the cornice passing directly into the chimney.

Fig. 104 shows the method of converting a pane in the window into a very excellent ventilator, which may be regulated according to pleasure. In this and the subsequent design it must be borne in mind that the entry of a draught when there is much wind must be prevented; and that if the current from without should be greater

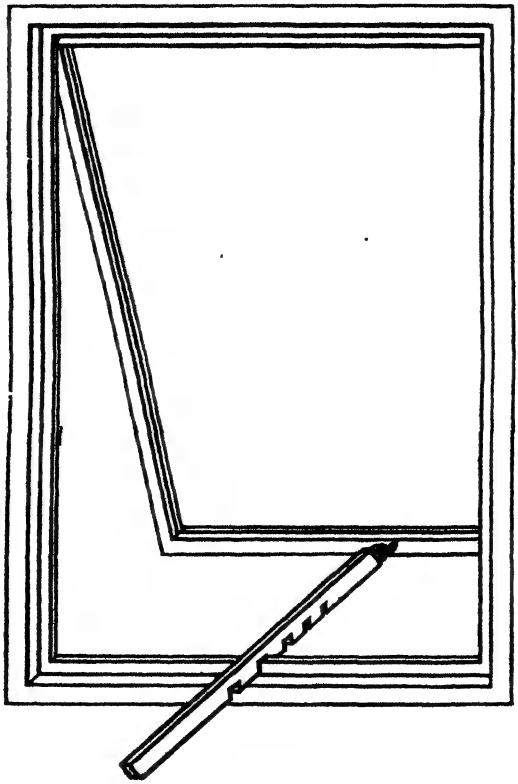


Fig. 104.

than that from within, the air which enters should be directed upward in the first instance, so that it may form a wave against the ceiling and become diffused, instead of blowing down directly on the heads of the inmates of the room.

There is another point to be considered, namely, that the ventilating window must be so made that it may not admit rain, for

otherwise the circumstance of wet without, would be the cause of stifling within. Both the following plans fulfil these conditions.

In Fig. 104 the pane opens obliquely outward, suspended from the top; and thus the vitiated air as it rises finds egress through the broad aperture, which will be seen from the section of a similar window in Fig. 105.

The pane of glass must, in the first place, be removed. This may be done by hacking away the putty from the back, and inserting a knife in the front between the glass and the sash,—a very troublesome operation, and one which generally results in breaking the glass. This is not, in some cases, a matter of much importance, as far as the mere value of the pane is concerned; but in others the pane may be a large one; and further, wilful waste is never to be encouraged; and in building, somehow or other, all sorts of old materials "come in" at one time or another; the amateur is therefore advised to take the glass out whole if he can, and this may be done by softening the putty—a receipt for which he will find in "useful hints" at the end of this volume.

Assuming, then, the aperture to be cleared, and the rabbet, from which the glass has been removed, to be scraped perfectly clean, a thin strip of wood is to be nailed all round so as to entirely fill up that recess, thus forming a broad flat edge to the aperture; and another, ⅜" square, is to be nailed around the frame on its inner edge to form a ledge all round, against which the moving window will fit when closed.

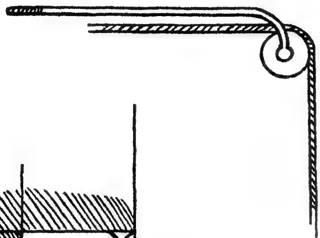
A frame must now be made to fit accurately into this space: it should be made of wood at least ½" thick, whilst the width should be about ⅜" less than that of the border into which it is to be fixed. Before the four pieces, however, are put together, the edge must be rebated, so that, when the frame is made up, a place may be formed in which the glass is to lie. A simple picture-frame will afford

the best model for the work at its present stage. And now we shall find the advantage of economy, for, if the pane taken out has been saved, it will do for the present frame, requiring only a strip cut off on one side and one end, so as to reduce it in size. This may be done with a glazier's diamond (which, by the way, will often be found useful), or even by the diamond in a ring, guided, of course, by a T-square or rule. It is scarcely our province to encroach on a glazier's business, and therefore, if the amateur is not desirous of increasing the range of his technical avocations, he may simply get a glazier to put in the glass; but to do such trifles oneself gives half the pleasure, so we will just say, get a pennyworth or two of putty, and, with a blunt short knife, such as an old table-knife broken off half-way, lay on putty all round the rebate: this is best done by taking some in the knife and pressing it crosswise against the edge of the rebate, scratching it off, as it were: professional glaziers mostly do this with their thumb. The putty should be laid pretty equally all round; the sheet of glass is then carefully placed and pressed equally all round, the putty being partially squeezed out. Looking now from the back of the glass, the surface of the rebate in which the glass rests will be visible, and care must be taken that the putty, which is now to be applied around the edge of the back, must not, when finished, pass beyond this, so that it may not be seen from the front: this edging of putty must be well pressed in, and may be rendered smooth by the knife being drawn along. The putty which was squeezed from between the glass and the rebate in the inside, will, subsequently, require removing, and any crevice that may remain must be filled up: this is called "inside puttying," and is best done a day or two afterwards, when the putty has become a little stiffened.

The frame is now to be hung: the hinges being screwed to its upper edge and to the under-side of the surrounding frame They must be countersunk in both, otherwise there would be an opening equal to the

thickness of the closed hinge. In affixing the hinges to the glazed frame, care must be taken that the screws are not placed immediately over the edge of the glass; for should they protrude through the wood in the slightest degree, or even force downward the inner surface of the frame, the pressure on the edge of the glass would cause it to crack.

Fig. 106.



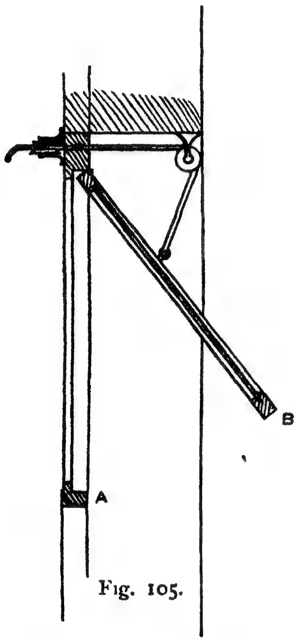


Fig. 107.

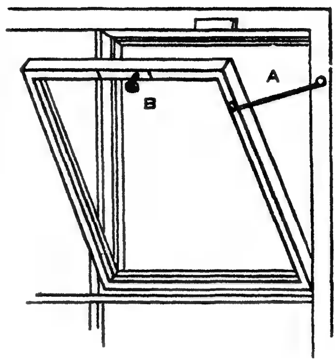


Fig. 105.

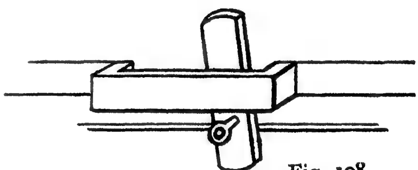


Fig. 108.

And now as to the method of opening and shutting the movable pane—a piece of hard wood, such as beech, birch, or oak, say ⅜″ thick and about 1½″ wide, is to be prepared, and in the edge of this, a number of recesses, slightly more than ⅜″ wide and about that depth, are to be cut. One end of this ratchet is to be attached by means of a loop and hook to the lower part of the frame of the movable pane, the other terminating in a kind of knob or handle. It will at once be seen that, by taking hold of the handle, the movable pane can

be opened outward, and may be fixed at any desired degree of opening, by allowing the rack to drop on the ledge at the bottom of the outer frame, so that the edge of the latter may catch in one of the recesses of the rack.

This arrangement, however, assumes that the ventilating pane is within convenient reach; in fact, for reasons already explained, the higher it is, the better. We give in Fig. 105 a sectional view of a similar window, arranged so that it may be opened and closed by means of a cord. Here A is the inside of the surrounding frame, and B the section of the movable glazed frame. The lower side of this should for the present purpose be made about double the breadth of the others, and of heavier wood; thus, if the three be made of pine, the fourth should be of oak or birch, &c. Into the back of this a small ring is to be screwed for the attachment of a cord, which is to pass over a pulley, either fixed to the soffit of the window, as shown in Fig. 105, or in an iron rod as shown in Fig. 106. The end of this may be tapped—that is, made screw-like at the ironmonger's, where workmen are mostly employed, or at any lock or blacksmith's—where at the same time the rod may be bent, and a loop formed at the end. "At a push," however, all these operations may be done by the amateur, even though he may not be provided with the proper stocks and dies for making the screw. The fact is, only half a dozen threads or so are required, and these may be made sufficiently well to answer the purpose by holding the wire in the left hand, and using the triangular file with the other, setting it rather obliquely across, and turning the iron round slowly until a spiral groove is made, which may be deepened by repeating the process; and of course the rod may be easily bent, and the loop made whilst red hot; so that the amateur is thus rendered independent, and can get his work done just at the precise minute when he wants it, instead of having to wait the convenience of the workman, and, after all, perhaps, to find his wishes not carried out.

A hole is now to be bored through the top of the fixed frame, and a pulley is to be screwed on the inside. The cord is then to be fastened to the ring and conveyed over the outer pulley through the hole, and over the inner pulley into the room.

It will, of course, be seen that by pulling this cord the window will be raised and will fall when released, the additional weight of the lower edge facilitating the closing. If the inner pulley be turned horizontally, the cord may be conveyed to the angle of the casement and there passed over another pulley for turning downwards: this avoids the light being disturbed by the cord moving about in front of the window by means of the draught; and it may then be coiled round two reversed hooks, so as to be out of the way. Either of these windows may be secured on the inside by bolts similar to those already spoken of in relation to the cupboard; and some such arrangement is necessary when the window is so situated that the opening may facilitate the whole casement being opened from the outside.

The latter plan is very well adapted for opening the fanlight over a street door, in order to allow the air, vitiated by the hall lamp and other circumstances, to escape, instead of travelling into the upper part of the house; and then, if the staircase window be slightly opened fresh air is supplied to each floor. It is needless to say that this latter is not proposed for the colder season, during which it becomes advisable to light a fire in the hall, or otherwise equalize the temperature of the house; but there is a great difference between warmed air and vitiated air (a fact not always remembered); but, however cold the weather may be, arrangements should be made that the air throughout the house may occasionally be changed by admission of fresh air below, and exit of impure air at the top of the house.

Fig. 107 illustrates another method in which the hinges are placed

at the bottom of the movable frame, which should be, on the whole, heavier than that described in the last system. The general construction is, however, the same, and need not therefore be repeated here; the difference being principally in the method of opening and closing.

It is convenient, in the first place, to assume the window open, the extent being limited by a chain at A, which may from time to time be regulated according to the prevailing state of the weather.

Now, the frame of the movable pane is provided with a cross tongue, shown at B, in Fig. 107, which is attached by a screw placed in the middle. The screw is what is called a *ring*-screw, made of iron, and should be so turned that the ring may be horizontal. At the edge of the framing above, a piece of wood, to receive the tongue, is screwed. The arrangement is shown enlarged in Fig. 108.

When it is desired to close the window, a "long arm," which is a wooden rod, having a square hook at the end, is used. This is raised, so that it may push against the projecting ring until the window is in its place. The end of the long arm is then moved along, and, by pressing against the longer end of the cross button, it is pushed into the recess in the piece above, and the window thus effectually bolted. In opening, the long arm is applied to the lower end of the cross button in a slanting manner, by which it is pushed aside, and the opposite end is released. The hook of the long arm is then inserted in the ring, and the window is thus drawn forward.

TO REPAIR A FLOOR.

We have often been annoyed by the occasional springing up or sinking of single boards of the floor, and we have noted, after constantly visiting at a house where this remained uncorrected, that, besides the other disagreeables, the neglected floor made its grievance known in time, in a very tangible manner, for the additional wear of the carpet around the edge of the misplaced board became a very wholesome warning, that the first little trouble of taking up the carpet and hammering a few nails into the board, would have saved much vexation and expense,—and a practical proof of the desirability of encouraging "amateur carpenters" was given.

But floors do not consist of the boards only: these are merely, as it were, the skin; and we will, therefore, look beneath the surface and consider the anatomy of the various kinds of floors. Amateur carpenters may not wish to construct their own floors, but they often make their own plans for houses they are about having built, and even if they only wish to give instructions to their architects, they will be all the more able to do so when they understand the construction of some of the leading portions of a building.

The boards, then, of floors lie upon a strong and well arranged framework of timber resting on the walls of the house: and this portion of the work is called the "naked flooring."

Floors are generally considered under three heads,—SINGLE, DOUBLE and FRAMED.

Single Floors (Fig. 109) consist of one row or tier of planks, called "FLOOR-JOISTS," bearing from one wall or partition to another, generally without any intermediate support. On these rest the floor-boards, whilst to their lower edge the ceiling is attached.

The joists in single flooring should never be less than 2″ in thick-

ness, nor even as small as that when it can be avoided, because they are liable to be split by the nails driven into them for fastening the floor-boards, and builders say they should never very much exceed 3″ in thickness. Twelve inches from joist to joist is the distance generally allowed, but this dimension should be from centre to centre of the joists. Strength to almost any extent may be given by adding to the depth of the joists, which must never be less than 9″ and diminishing the distance between them ; and they may be made firm and prevented from buckling or twisting by what are called "HERRING-BONE STRUTS" between them. These struts are short pieces of batten, which should not be less than 1½″ thick and 3″ wide: these are placed diagonally between the joists to which they are nailed in a double series, that is, crossing each other: they should be made to range in a straight line, so that none of their effect may be lost, but that each pair may give support to those adjoining, and the rows should be at 5′ or 6′ apart. The struts should be cut at the ends with the same bevel or inclination, which must be regulated by, 1st, the depth of the joists ; and, 2nd, their distance apart. Care must be taken not to split the ends of the struts, and therefore, if the amateur is applying them, he should bore them with his gimlet before placing them: there should be two holes at each end, and, as already explained, nails for such purposes should be at right angles to the piece of wood through which they are passing.

This strutting should be done to single flooring under all circumstances, as it adds materially to their firmness and strength, by making the joists transmit any stress or pressure from one to another.

The loosening of floor-boards, and the consequent creaking, arises sometimes from the absence of struts, and, at others, from the giving way or displacement of one or more of the struts, in consequence of which some of the joists may have become slightly twisted,

so that they do not present the flat surface of their upper edge, but an angle to the support of the floor-board, and thus yield to pressure. A few floor-boards should, in the first place, be taken up, and, should it be discovered that there are not any struts, and that the joists are twisting (and who can say what strange things may not be discovered in these days of "running up" houses by contract *to sell?*), they should be added: this really is not such a difficult task as might be supposed, and we do not think it will be found beyond the powers of an amateur; at all events, he could superintend the operation, the rougher work being done by a working carpenter.

It will of course be understood that to nail in the struts under such circumstances is a very different operation to that of affixing them during building before the ceiling of the room below was in its place; that it will thus be impossible to reach the nails at the lower end of the pieces, and that there is not even room to move the hammer freely; but these obstacles do not in any way interfere with the operation we have in hand. Prepare a quantity of battens* 2″ deep and 1′ thick, boring holes at intervals, and screw them to the sides of the joints; one at 1″ from the lower edge, and the other at ½″ from the top. The struts are to be inserted diagonally between these.

Now, the struts used in single floors are cut as shown in Fig. 110; but those used for our present purpose should be cut so that their ends fit exactly into the right angle formed by the upright surface of the joist and the lower edge of the batten (Fig. 111). The struts should be of exactly the length required, and, being at first placed slantingly, may be forced into their correct position by a few taps of the hammer on their edge. They will scarcely require any nails, except one at their upper end. This method is shown at A, Fig. 112.

If a joist has become only very slightly twisted, the struts on the

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* Battens are lengths of timber from 2″ to 6″ broad, and from ⅝″ to 2″ thick.

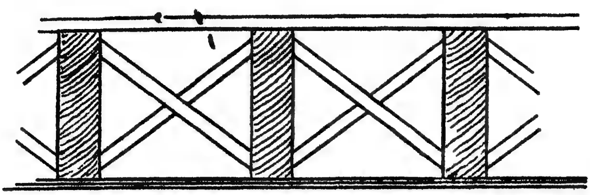


Fig. 109.

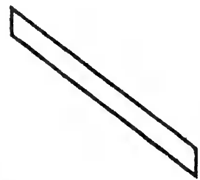


Fig. 110.

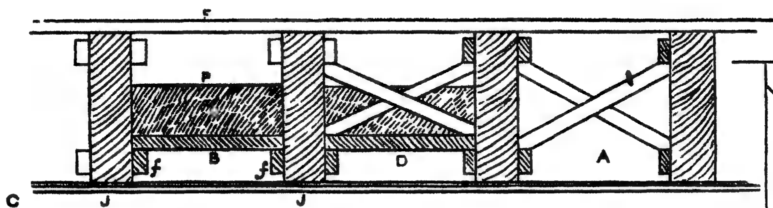


Fig. 112.

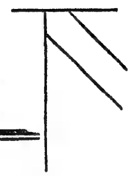


Fig. 111.

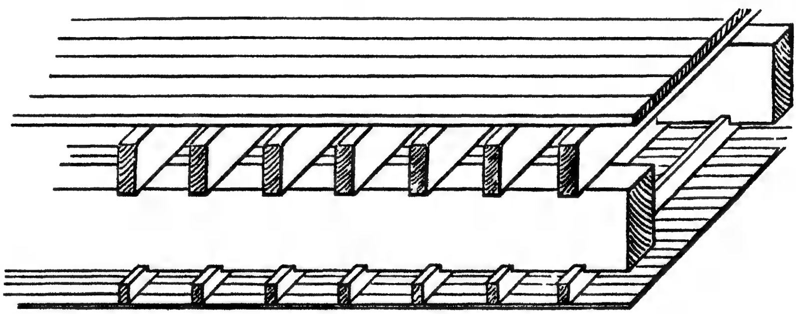


Fig. 113.

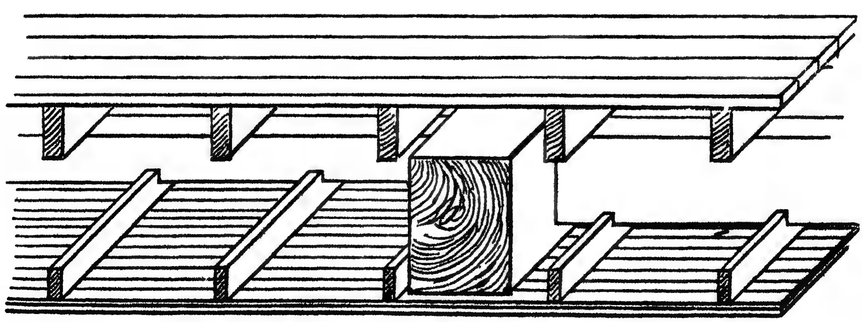


Fig. 114.

one side may be cut slightly longer than those on the other. These being first forced in on the opposite side, the joist will, in many cases, be returned—that is, when the evil has not extended too far: this lengthening of the struts should, however, be done very gradually—commencing almost imperceptibly at a very distant part of the joist.

Where it is found that the joist has twisted to a serious extent, it is not advisable to attempt to restore it to its original position, but the effort should be confined to fixing it, so that further twisting may, if possible, be avoided; and, therefore, struts, forced between battens and cut to suit the circumstances, should be adopted. These should not be confined to the three joists immediately involved, but should be carried on to several other pairs, in order to offer as much resistance to further twisting as possible. The upper edge of the joist should then be brought to a level surface by nailing a piece of wood on it.

The efficiency of single flooring is materially affected by the necessity which constantly occurs in practice of "trimming" round fireplaces and flues and across vacant spaces.

TRIMMING is the mode of supporting the end of a joist by tenoning it into a piece of timber crossing its ends—called a "TRIMMER"—instead of running it on so as to rest on the wall which supports the other joists; for it would be manifestly unsafe to continue the timbers under a hearthstone. The trimmer itself requires, of course, to be supported at its ends by the joists which run the whole length: thus let us suppose that a space to be covered by the hearthstone is to be left; the joists immediately at the sides of such space of course rest on the wall; those which are between them, however—which would, if continued, pass under the fireplace—are cut off some few feet shorter, and their ends are tenoned into a cross-piece placed parallel with the front of the hearthstone, the ends of which are tenoned again into the left and right joists. These are called "TRIMMING JOISTS," and

are necessarily stouter than if they were required to bear only their own share of the stress. A brick arch, called a "trimming arch," should then be thrown from the wall to the trimming joist, and on this the hearthstone may safely rest.

One objection to single flooring, is that sound readily passes through from the rooms above to those below; and, as this may cause some annoyance in a house, we think it may not be out of place here to describe the remedy.

In Fig. 112, which is a section of a single floor, J J are the floor-joists; F, the floor-boards; and C, the ceiling; *f f* are fillets, or battens, nailed to the joists, on which a board, B—called a SOUND-BOARD—is placed, and on this, PUGGING, P—which is a coarse sort of mortar, &c.—is filled in.

The cross-struts, if previously placed, of course offer an obstacle to this; but the boards must then be laid down in pieces, their ends being cut to allow for the extremities of the struts; but if this plan is decided upon whilst the house is being built, the same battens will serve for both; the battens being placed first, then the boards, and lastly, the struts. This is illustrated at D in Fig. 112.

Double Flooring.—When the rooms are large, the framing for the support of the floor consists of two rows of beams, the lower supporting the higher. The first are called "binding joists," or "binders," and the second (which are really the floor-joists) are termed the "BRIDGING JOISTS." The binders in this system are really the support of the floor, and run from wall to wall. A third assemblage of timbers, called "ceiling-joists," also belongs to this system: the ceiling-joists are notched and nailed to the lower surfaces of the binders, and to these the laths for the ceiling are nailed. It must, however, be noted that the notch must be taken entirely out of the ceiling-joists, and not out of the binders, the lower edge of which must not on any account be weakened. If the bridging joists are

of the proper thickness, the binders need not be more than 6′ 0″ apart. This system is called "double flooring," and is shown in Fig. 113.

Framed Flooring.—When the extent of the floor is such that the lower rows of beams would be too much weakened to support the upper ones and the floor, strong beams, called "GIRDERS," are introduced, so as to divide the length of the apartment into several parts, as may be required for bearing the timbers above. The girders thus introduced should always be placed in the breadth, or least dimension, of the rectangle or floor; and the binders should not be fixed opposite to each other, so that the girder may not be weakened by a deep mortise on each side. The binding joists are framed into the girders by means of tusk tenons, and the bridging joists are notched on to binders. This system is called "framed flooring," and is represented in Fig. 114.

GENERAL PRINCIPLES OF BUILDING

IN BRICK AND STONE.

The object aimed at in these pages is not only to enable the amateur to construct buildings, &c., in wood, but to give him such information as to building in general, that he may be able to superintend works being done for him, and to appreciate the plans and designs of his architect.

For, be it clearly understood, we do not by any means advocate the notion of every man being his own architect,—a plan which results generally, if not always, in failure; but there are repairs, alterations, additions, &c., constantly required, the carrying out of which are quite within the range of the powers of the amateur; and further, in conjunction with the clerk of the works, a gentleman, who has a fair knowledge of building construction, will find he can serve his interests, and, at the same time, derive amusement, from an intelligent supervision of works being carried out for him.

We therefore give the following outline, based principally on the authority of the late Mr. Hoskings and Mr. Nicholson.

The average size of bricks in this country is a fraction under 9″ long, 4½″ wide, and 2½″ thick, and, in consequence of this uniformity of size, a wall of this material is described as of so many bricks in thickness, or of the number of inches which result from multiplying nine inches by any number of bricks: a 9″ or one brick wall; a 14″ wall, or one brick and a half (13½″ would be more correct, in fact; for although a joint of mortar must occur in this thickness, yet the fraction under the given size of the brick is enough to form it); 18″ or two bricks; and so on.

The great art in bricklaying is to preserve and maintain a "BOND," to have every course perfectly horizontal, both longitudinally and

transversely, and perfectly "PLUMB;" which last, however, may not mean upright only—though that is the general acceptation of the term—for the plumb-rule may be made to suit any required inclination, as inward against a bank, for instance, or in a tapering tower. This will, perhaps, be better understood if we ask the reader to imagine that he has drawn on a screen a copy of a wall of brick-work, each of the vertical joints in the alternate courses being exactly over those below, and all being perfectly perpendicular to the horizontal lines at the joints: now, if he allows this screen to fall backwards at the top, the bottom remaining as it was, the surface thus becoming a slanting one, the exact relation of the lines to each other will remain the same, although the whole plane has become inclined, and thus the joints are still "plumb."

We do not by any means intend this to be a dictionary of slang, but we may just explain that when the reader hears a bricklayer talk about "keeping the perbends," he may interpret it to mean keeping the "perpends," the diminutive for keeping the perpendiculars.

Bond in brickwork is that arrangement by which the bricks of every course cover the joints of those of the course below it, and so tend to make the whole mass or combination of bricks act as much together or dependently one upon the other as possible. The object of this will be understood on reference to the diagram, Fig. 115: here it is evident, from the arrangement of the bricks, that any weight placed on A, would (supposing, as we are obliged to suppose, that every brick feels equally throughout its whole length a stress laid on any part of it) be carried down and borne alike in every course from A to C. In the same manner the brick A is upborne by every brick in the line, B C, and so throughout the structure.

But this forms a longitudinal bond only, which cannot extend its influence beyond the width of the brick; and a wall of 1½ brick or two bricks thick built in this manner, would have the effect of three

Fig. 115.

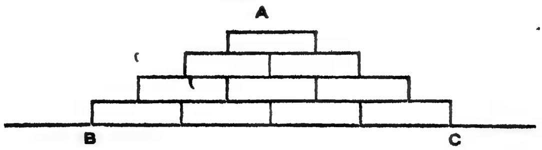


Fig. 116.

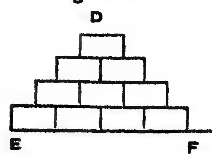
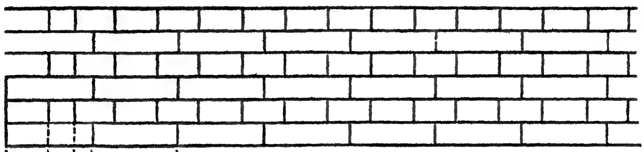


Fig. 117.



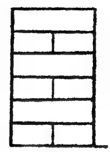


Fig. 118.

Fig. 119.

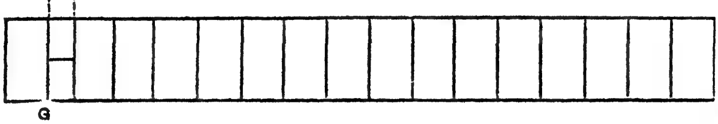


Fig. 120.

Fig. 121.

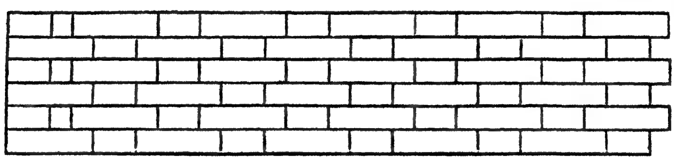


Fig. 122.

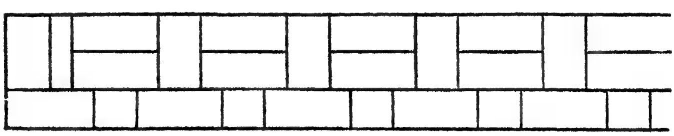
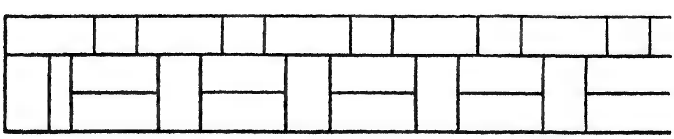


Fig. 123.



or four half-brick-thick walls placed behind each other, but without being in any way connected, and thus acting independently of each other.

In order to produce a transverse, and yet preserve a true longitudinal bond, the bricks are laid in alternate courses of "headers" and "stretchers," or of ends and sides, as shown in Fig. 117, thus combining the advantages of the two modes of arrangement, A B C, (Fig. 115), with D E F (Fig. 116); each brick in Fig. 117 showing its long side in front, or being a stretcher, will have another line parallel to it, and on the same level on the other side, to receive the bricks, showing as headers in front, which in their turn bind by covering the joint between them, as shown in the end of such a wall, Fig. 118. Thus a well-bonded nine-inch, or one-brick wall, is produced.

Figs. 119 and 120 show the method of placing the bricks in the two courses. This is called "**English bond,**" the characteristic feature of which is that one course consists entirely of stretchers, and the next entirely of headers.

Thicker walls are constructed in a similar manner by the extension of the same principle.

The breadth of a brick being exactly equal to half its length, it is impossible, commencing from a vertical end or quoin, to make a bond of whole bricks, as the joints must of necessity fall one over the other. This difficulty is obviated by cutting a brick lengthwise into two parts. One of these is placed next to a whole header, inward from the angle, and forms with it a three-quarter length between the stretchers above and below, making a regular overlap, which may thus be preserved throughout. Half-headers so applied are technically termed "closers." This is seen in the joints in the heading courses next the upright angle of the wall, Fig. 117, and the first joint inwards from the square end by the headers in the plan at G in Fig. 120. A three-quarter stretcher is obviously as available for this purpose as a half-header; but the latter is preferred, because by the use of it, uniformity of appearance is preserved, and whole bricks are retained in the return.

In walls of almost all thicknesses above 9″, to preserve the trans-

verse, and yet not destroy the longitudinal bond, it is frequently necessary to use half-bricks; but it becomes a question whether more is not lost in the general firmness or consistence of the walls by that necessity than is gained in uniformity in the bond. It may certainly be taken as a general rule, that a brick should never be cut if it can be worked in whole, for a new joint is thereby created in the construction, the difficulty of which consists in obviating the debility arising from the constant recurrence of joints. Great attention should be paid to this, especially in the quoins of buildings, &c., in which half-bricks most readily occur; and then it is not only of consequence to have the greatest degree of consistence, but the quarter-bricks used as closers are already admitted, and the weakness consequent on their admission would only be increased by the use of other bats, or fragments of bricks.

Another mode of binding brickwork which may be supposed to have arisen from the appearance of the end of a wall according to the former mode of arrangement, instead of placing the bricks in alternate courses of headers and stretchers, places headers and stretchers alternately in the same course. This is shown in Fig. 121. The plans below this, Figs. 122 and 123, are of two courses of a 14″ wall, with their bond, showing in what manner the joints are broken in the wall —horizontally as well as vertically—on its face. This is called "**Flemish bond.**" Closers are necessary to both varieties of bond, in the same manner and for the same purpose. Half-bricks also will occur in both; but what has been said with reference to the use of these in the former, applies even with more force to the latter, for they are more frequent in Flemish than in English bond, and its transverse tie is therefore rendered less strong. Their occurrence is a disadvantage, to obviate which every care should be taken.

For further information in relation to brickwork, see "Building Construction and Drawing for Bricklayers." By Ellis A. Davidson.

The arrangement of the joints, however, in Flemish bond, presenting a neater appearance than that of English bond, it is generally preferred for external walls when the outer faces are not to be covered with stucco or plaster composition of any kind. But English bond should have the preference when the greatest degree of strength and compactness is considered of the highest importance, because it affords, as we have already noticed, a better transverse tie than the other.

It is a curious fact that what is in England called Flemish bond is unknown in Flanders. In Flanders, Holland, and Belgium, which are all bricklaying countries, no kind of bond is found but what is known in England as English bond.

It has been attempted to improve the bond in thick walls by laying *raking*, or oblique courses, between external stretching courses, and reversing the direction of the slant each time the raking course recurs. This obviates whatever necessity may exist for using half-bricks in the heading courses, but it leaves triangular interstices to be filled up with bats. In the herring-bone bond, the rake starts from both sides, meeting in the middle of the thickness of the wall, and thus, in addition to the triangular bats required to fill up the spaces at the edge of the starting course, half-bricks are necessary to fill up the row of square vacant spaces left along the middle line. Neither of these modes should be adopted in the construction of walls of a less thickness than three bricks, and that, indeed, is almost too thin to admit of any great advantage from them.

Skilful and ingenious workmen are well aware of the necessity of attending to the bond, and are ready both to receive and practise an improvement, but generally the workmen are both ignorant and careless in preserving it, even according to the common modes. Their work should, therefore, be strictly supervised as they proceed with it, and it is in cases such as these, that the few hints here given will be found useful.

Not second in importance to bonding in brickwork, is that it should be perfectly plumb, or vertical, and that every course should be perfectly horizontal or level, both longitudinally and transversely. The lowest course in the footings of a brick wall should be laid with the strictest attention to this latter particular, for the bricks being of equal thickness throughout, the slightest irregularity or incorrectness will be carried into the courses above, a defect only rectified by using a greater or a less quantity of mortar in one part or another; this is, however, a very unsafe resource, for the wall will, of course, yield unequally to the superincumbent weight as the work goes on, and the evil will thus be perpetuated.

To save the trouble of keeping a plumb-rule and level constantly in his hand, and yet to insure correct work, the bricklayer, on clearing the footings of the wall, builds up six or eight courses at the external angles, which he carefully plumbs and levels across from one to the other. These form a gauge for the intervening parts of the courses; a line being tightly strained from the one end to the other, resting on the upper and outer angles of the gauge bricks of the next course to be laid; and with this he makes his work range.

If, however, the length be great, the line will of course sag by its own weight; and it must therefore be carefully set and propped up at intervals.

Having carried up three or four courses to a level with the guidance of the line, the work should be proved with the level and plumb-rule, and particularly with the latter at the quoins and reveals, as well as on the face. A smart tap with the end of the handle of the trowel will generally suffice to make a brick yield what little it may be out whilst the work is so green, and not injure it. Good workmen, however, take a pride in showing how correctly their work will plumb without tapping.

To work, which is circular on the plan, both the level and plumb-

rule must be used, together with a gauge-mould or a ranging-trammel to every course, as it must be evident that the line cannot be applied to such in the manner just described. To every wall of more than one brick thick, two men should be employed at the same time, one outside and the other in: one man cannot do justice from one side even to a 14″ wall. Inferior workmen and apprentices are frequently employed as inside men, though the work there is of quite as great importance as exteriorly, except for neatness, and for that only if the work is to be shown on the outside.

In the operation of bricklaying, the workman holds the trowel in his right hand, and with the left he takes up the bricks and lays them in their places. Taking up the mortar with his trowel, he throws it on the course last laid, and spreads it over the surface to form a bed for the brick which he is about to set. Whatever mortar may bulge over the outer edge of the work below is struck off, and being caught on the flat face of the trowel, is put against the side or edge of the last brick laid in the new course; then taking up a brick, he presses it down in its place until its upper and outer angle comes exactly to the line—and if this be not readily effected by the hand, a slight drawing blow from the obtuse point of the trowel accomplishes the desired effect, or a tap with the end of the handle both draws it and settles it down farther than the hand can press it. The small quantity of mortar that is pressed out in the front by this operation being struck off, the joints are neatly drawn by compressing the mortar with the point of the trowel, and thus producing a fine smooth surface —that is, if the work is to be seen; for if it is to be plastered, the rough face is left, that the plastering may the more readily attach itself, and the joint is not drawn at all; but the workman proceeds in the same manner with the next brick in advance along the course, or to fill in behind the one he has laid in the front to meet the work of his mate on the other side of the wall.

This is the common mode of laying bricks. They should not, however, be merely *laid*. Every brick should be rubbed and pressed down in such a manner as to force the slimy matter of the mortar into the pores of the bricks, and so produce absolute adhesion. Moreover, to make the brickwork as good and as perfect as it may be, every brick should be made damp or even wet before it is laid, otherwise it immediately absorbs the moisture of the mortar, and its surface being covered with dry dust, and its pores full of air, no adhesion can take place; but if the brick be damp and the mortar moist, the dust is enveloped in the cementitious matter of the mortar, which also enters the pores of the brick, so that when the water evaporates their attachment is complete, the access and retention of air being thus altogether precluded. To wet the bricks before they were carried up to the bricklayer would, by making them heavier, materially increase the labour of carrying them; in hot weather they would moreover become dry again before they could be used, and for the workman to wet every brick himself would be an unnecessary waste of his time. Boys might, therefore, be advantageously employed to dip the bricks on the scaffold, and supply them in a damp state to him. A watering-pot, with a fine rose to it, should also be used to moisten the upper surface of the last laid course of bricks preparatory to spreading the mortar over it. In bricklaying, with quick-setting cements, these matters are of even more importance; indeed, unless the bricks to be set with cement are quite wet, it will not attach itself to it at all.

As mortar is a more yielding material, used in brickwork merely for the purpose of making detached portions of the staple adhere, by filling up the interstices and producing exhaustion of air, and the object being to produce as unyielding and consistent a mass as possible, it will be clear that just as much of it should be used as is sufficient to produce the desired result, and no more. No two bricks should

be allowed to touch, because of their inaptitude to adhere to each other, and no space between them should be left unoccupied by mortar, which may produce adhesion. When the bricks are a fraction under 2½″ thick, no four courses of bricks and mortar should exceed 11″ in height, and if they are fully that thickness, four courses should not reach 11½″. The result of thick beds of mortar between the joints is that the mortar is pressed out after the joint is drawn on the outside of the wall; and this projecting mortar being convex, instead of slightly concave, the joints catch every drop of rain that may trickle down the face, and are thus saturated. The moisture freezes, and in thawing bursts the mortar, which crumbles away, and the necessity for frequently restoring the joints, or "pointing," is created.

Bricklayers, in working, lay the mortar on the course last finished and spread it over the surface with the trowel, without considering or caring for it that they have put no mortar *between* the bricks of that course except in the external edges of the outside vertical joints; and that the mortar is not, or ought not to be, sufficiently thin to fall into the joints by its own weight; and that unless they press it down, half the height of the space between the bricks remains, in every case, unoccupied, and the wall, in consequence, is hollow, incompact, and necessarily imperfect. To obviate this it is common to have a thick wall "grouted" in every course—that is, mortar made thin and called GROUT is poured on and spread over the horizontal surface of the work, that it may run in and completely fill in the joints. This, at the best, is but doing with the grout what should have been done with the mortar; and the difference between the two consisting merely in the quantity of the water they contain, mortar must be considered the best; for the tendency of grout is, by hydrostatic pressure, to burst the wall in which it is employed, and, moreover, it must, by taking a much longer time to dry and shrink than the rest of the mortar of the beds and external joints,

make and keep the whole mass unstable, and tend to injure rather than benefit it. Filling up, or flushing up, every course with mortar, is, therefore, far preferable, and may be done with very little exertion on the part of the workman.

It is a very common thing for two sorts of mortar to be used in the same wall—a finer and whiter for the outside, and a coarser for the inside work; the former made with cleaner and finer sand and a greater quantity of lime than the latter, with the intention of exposing a better-looking and more durable material to the view and the weather. But the sand ought to be as clean as it can be made for the mortar to be used in bricklaying, therefore there should be no possibility of making a difference in that particular, and the addition of a greater quantity of lime than is necessary to make good mortar, causes it to be less durable, and occasions a sacrifice of an important quality, for the sake of an unimportant advantage. Moreover, the mortar which contains the greater quantity of lime will yield or settle more than that which has the larger proportion of sand.

The whole of the walls of a building which are to sustain the same flooring and the same roof, should be carried up simultaneously. Under no circumstances should more be done on one part than can be reached from the same scaffold until all the walls are brought up to the same height, and the ends of the part first built should be "racked back," as in Fig. 115, and not carried up vertically, with merely the toothing necessary for the bond, as in Fig. 117. Brickwork should never be carried on in frosty weather, nor even when it is likely that frost may occur before the walls can be covered in or become so dry as not to be affected by frost. Covering an unfinished wall with a layer of straw is, when frost may be expected, a very useful precaution. On the straw, weather-boarding should be laid, to prevent the access of moisture from rain or snow. Merely wet weather may be guarded against by following the directions

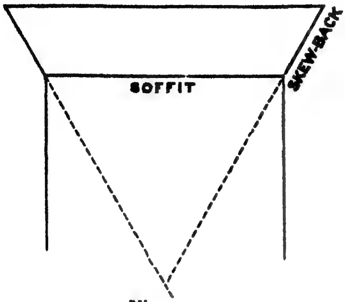


Fig. 124.

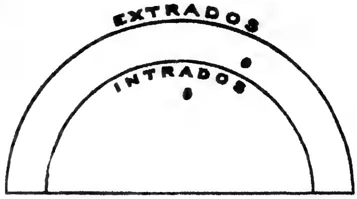


Fig. 125.

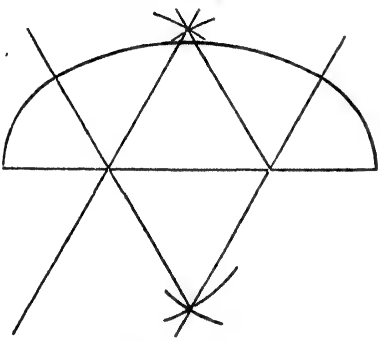


Fig. 126.

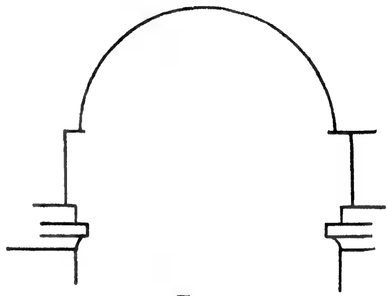


Fig. 127.

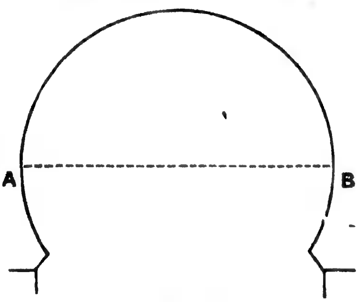


Fig. 128.

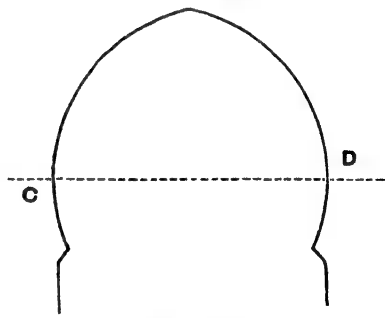


Fig. 129.

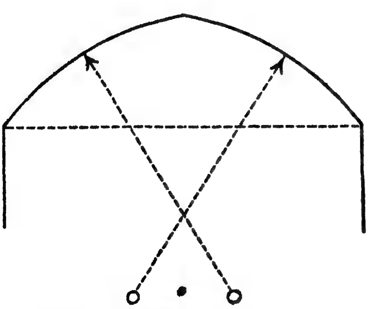


Fig. 130.

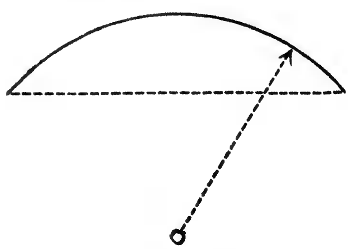


Fig. 131.

given above as to flushing every course of the work well up with mortar, so that no interstice into which the water may insinuate itself may be left; and by covering the walls with boards, to act as a coping when the men are not actually at work on them: the joints in the face of a wall that is not to be plastered in any way, should be thus protected with great care.

It will be unnecessary here to define **Arches,** but it will be well that the amateur should be acquainted with the technical terms commonly used in relation to them, as PIERS *on* which, and ABUTMENTS *against* which, an arch rests; the SPAN or width between the points at which the arch starts from the IMPOSTS, or upper part of the supports on which it rests; the "SPRINGING," or line connecting these points; the "SKEW-BACK," or slanting side of a straight arch (as seen over the tops of rectangular windows); the "HAUNCHES," or lower segments on each side; as distinguished from what common bricklayers call the "scheme part," or upper segment of the arch; the "INTRADOS," or whole interior or lower surface; the "EXTRADOS," or whole exterior or upper surface; the "CROWN," or summit of the arch; the "VOUSSOIRS," or separate stones composing the arch; and the "KEY" or "KEYSTONE," which forms the wedge by which all the rest are confined to their places, and locked, as it were, together.

As far as their form is concerned, arches are classed as follows: Straight, Fig. 124, to the underneath surface of which the term "SOFFIT" is applied, instead of intrados; Semicircular, Fig. 125, which, as its name implies, consists of half a circle; the Elliptical, Fig. 126; the Parabolical, the Hyperbolical, the Cycloidal, the Catenarian—which is in form the reverse of the curve taken by a chain or heavy rope when suspended from two points; the Stilted, Fig. 127, which is simply formed by raising the springing above the capitals; the Horse-shoe, both round and pointed, Figs. 128 and 129, in which the curves are carried below the line on which the centre or centres from

which they are struck are situated; the springing is on the line of centres, the continuation of the form below that, being merely ornamental, since the real bearing is at A B and C D; and the whole series of arches belonging to the Gothic style. These may be briefly classed as the Lancet Arch, or Early English period, 1189 to 1307, in which the radius of the arcs is greater than the width of the arch: the centres are therefore placed outside the span, but on the springing line; the Equilateral,* in which the radius of the curve is equal to the span, the extremities of which are the centres†; the Segmental, Fig. 130, formed of two segments of circles, the centres of which are placed below the springing (this must not be confused with the Segment arch, Fig. 131, which consists of one arc only); and the Tudor, or four centres. The parabolic, hyperbolic, cycloidal, and catenarian are not likely to be required by the amateur, and it is not deemed necessary, therefore, to give illustrations of them. The methods of constructing them geometrically are given in our manual of "Linear Drawing."

In relation to the construction of arches in brickwork, we will first mention those called "**Plain arches.**" These arches are made up entirely of the bricks in their common form; they are laid on their edge on the centering, or wooden framework, on which the arch is temporarily supported, in which position it will be clear there must be a wedge-like interstice between each two; since the extrados will, of course, be larger than the intrados, and this has to be filled in with mortar. Now, it will be clear that the farther the opening between the bricks is removed from the centre, the wider it will be, and that this increases when the intrados is of a small radius; therefore, unless the curve is to be very flat, the arch, instead of being built of whole bricks standing on their narrow end, should be constructed of

* Decorated period, 1307 to about 1390.

† The Ogee Arch, which was occasionally used during the same period.

double rings of half-bricks,—by this we do not mean bricks cut in halves, but laid on their long edge, so that they are only half a brick high; the next ring, therefore, covers the joints of the previous one; and as each ring is struck with a larger radius, the more rings there are, the more does the space between the bricks of the outer curve become diminished.

Rough Arches.—In these the bricks are roughly cut with an axe until they are of the form required: they are generally used over openings, such as doors or windows, when the work is to be plastered over, or in backs of walls, &c., where the joints are to be pointed.

Gauged Arches are built of bricks which are cut and rubbed to gauges or moulds, so as to fit together exactly and form the required arch, as if they were really cut out of stone. Although the system of cutting and rubbing bricks has been used for many years, there is no doubt that we can now dispense with it. It must be clear that chipping and otherwise altering the shape of a brick injures the surface it received during its burning in the kiln. It is also an immense waste of labour; and further, there is but little doubt that in the hands of any but first-rate workmen, the question of absolute accuracy of fit is but little attended to, many deficiencies being covered by the mortar. It is of course necessary to construct brick arches in this way when a single one or very few are required, but in other cases they may be moulded to order to suit the form of arch required, which will be found to be by far the better mode of procedure.

It is generally held that nothing but its own components should be admitted into a brick wall, except what is absolutely necessary for its connection with the other parts of a building, such as wall-plates, templets, lintels, and wood bricks, and that these latter should be avoided as much as possible. Wall-plates are applied to receive the ends of the joists, and distribute the weight of the floor to which

they belong, equally upon the whole length of the wall. If the joists rested on single bricks, they would crush those immediately under them, whilst no weight at all would rest on the bricks between them. In framed floors, which have already been described, the wall-plate is not necessary, for the weight of the floor is borne by a small number of girders, under which separate stout pieces of timber, 2′ or 3′ in length, are placed, and these answer the same purpose as a wall-plate in distributing the weight over a greater area than that covered by the girder. Lintels are used over rectangular openings in walls, in which they preserve the squareness of form, and are also useful to the joiner in attaching the internal wooden fittings. They should not, however, be depended upon to support the weight of the wall above them, which should be borne by a discharging arch built over them, and this should not be wider than is absolutely necessary.

Wood bricks are used to prevent the necessity of plugging walls (that is, driving wedges of wood into the joints, as described at page 31) for the attachment of the joiner's work. They are pieces of timber generally cut to the size and shape of a brick, and worked in as bricks in the inner face of the wall where it is known the joiners will have need for something of the kind. This is principally in the jambs of the windows and doors for their fittings, and along the walls at proper heights for the skirtings or the wainscoting, as the case may be. Wood bricks are, however, going gradually out of use, and instead of them a piece of timber, about ¼″ or ⅜″ thick, is inserted. This is found to shrink less than a wood brick, whilst it answers every purpose equally well.

There is a great objection to the use of bond timbers in walls; they are, in fact, being superseded by hoop-iron. It will be clear that, in the event of a fire, the wood is likely to be at once burnt away, leaving the brickwork above unsupported; and thus a wall, which might otherwise have escaped, is rendered unsafe. The ex-

tension of the manufacture of iron has aided in the rejection of wood in the structure of walls, which may, perhaps, be in time, wholly superseded. The thin strips of hoop-iron are laid in the bed-joints of mortar at intervals more or less frequently according to the character of the work, with the best effect in respect of compactness and comparative strength.

It will be generally found that a brick wall built with mortar and faced with ashlar, has settled invariably to a greater or less extent as the work has been more or less carefully performed. Indeed, in the nature of things, it cannot be otherwise, unless the brick backing be worked in some cement which sets and hardens at once; for the outer face is composed of an unyielding material, with few and very thin joints, which, perhaps, do not occupy a fiftieth part of its height, whilst the back is built of an infinity of small parts, with fully one-eighth of its height of joints, that must yield both to pressure and shrink in drying. Some part of the ill effect attendant on this is obviated by the bond stones which tail in or run through the wall and tend to keep the discordant materials together; but still much of it remains, and, besides this, the internal, or cross-walls, which have no stone in them, will either settle down and shrink away from the external walls, or drag them inward, as they happen to be well or ill bonded or tied. For these reasons, brickwork built in this manner with masonry should be executed with exceedingly well-tempered mortar, made with no more lime than is absolutely necessary to cement the particles of sand together, and the sand again to the bricks, worked as stiff as it can be, and laid in as thin courses as will answer the purpose required of it. Above all, work of this kind must not be hurried, but allowed time to dry and shrink as it goes on.

It is absolutely necessary that the top of every brick wall which is not protected by a roof should be covered or COPED in some manner,

or it will soon be destroyed by the weather. This is sometimes done by means of a course of bricks set across it on their thin edges in cement, and called a "BARGE COURSE;" but it is a very imperfect covering, for water will trickle down the face of the wall on both sides, as the coping can be no longer than the thickness of the wall; and further, the water is likely to wear away the mortar and sink into the vertical joints. Two double courses of plain tiles may be put side by side under the barge course, making a projection over either face of about 1½". This is much better than the barge course alone; but still the covering receives no inclination outward to throw off the water, the upper surfaces being all horizontal. The same objection exists to foot-paving tiles, which are also used as a coping,—but none of these methods is available for walls above 9" in thickness. Stone coping, which may be made of sufficient width and be both weathered and throated, is much to be preferred.

We now proceed to give, as briefly as possible, some information as to building in stone—restricting ourselves to walling. The footings of stone walls ought to be constructed of large stones, which, if not naturally nearly square, should be reduced by the hammer to a rectangular form and to an equal thickness in the same course; for, naturally, if the beds of the stones in the foundation are not level, the remainder of the superstructure, resting on some point which may be higher than the other part, is left otherwise unsupported, and will be apt to give way. As in brickwork, the stones must be set so as to break joint—that is, each vertical joint in an upper course must be over a stone in the course immediately below it, and not over a

The stones composing the foundations of thin walls may be so disposed that their length may reach across each course from one side of the wall to the other. In thicker walls, where the difficulty

is greater in procuring stones of sufficient length to reach across the foundation, every second stone in the course may be a whole stone in the breadth, and each interval may consist of two stones of equal breadth, that is, placing header and stretcher alternately.

When, however, these stones cannot be conveniently obtained; from one side of the wall, lay a header and stretcher alternately, and from the other side lay another series of stones in the same manner, so that the length of each header may be two-thirds, and the breadth of each stretcher one-third, of the breadth of the wall, and so that the back of each header may come in contact with the back of an opposite stretcher, and the side of that header come in contact with the side of the header adjoining the said stretcher. In broad foundations, where stones cannot be procured for a length equal to two-thirds of the breadth of the foundation, build the work so that the upright joints of any course may fall in the middle of the length of the stones in the course below, and so that the backs of each stone in any course may fall upon the solid of a stone or stones in the course below.

The foundation should consist of several courses, of which each superior course should be of less breadth than the inferior one—say 4″ on each side in ordinary cases, and the upper course project 4″ on each side of the wall rising above it. The number of courses must be regulated by the weight of the wall, and by the size of the stones of which the foundation consists.

A wall which is built of unhewn stones is called a "**Rubble wall,**" whether with or without mortar. There are two kinds of rubble-work—COURSED and UNCOURSED.

In **Uncoursed rubble** the stones are laid promiscuously in the wall, without any attention being paid to placing them in rows. The only preparation which they undergo is that of knocking off the sharp angles with the thick end of a tool called the "scabling hammer."

In **Coursed rubble** the stones are roughly gauged and dressed by the hammer, and thrown into different heaps, each heap containing stones of the same thickness. The masonry is then laid in courses, which may be of different thicknesses; nor need all the stones in the same course be of the same height, for two are sometimes placed to make up the height of others in the course. These two styles are constantly used, especially in the country in building churches, the dressings round the windows and the angle quoins being "tooled;" and they are also largely used in walling.

In towns, however, walls are most commonly built, or rather faced, with what is called "**Ashlar Work**;" in which the stones are well squared and tooled on their surface, and are made of various sizes, according to convenience or the character of the building. Brick backings are common in London, where brick is cheaper, and stone backings in the north of England and in Scotland, where stone is plentiful. Walls faced with ashlar and backed with brick or uncoursed rubble are liable to become convex on the outside, from the greater number of joints, and from the greater quantity of mortar placed in each joint, as the shrinking of the mortar will be in proportion to the quantity, as already explained; and therefore a wall of this description is much inferior to one in which the facings and backings are of the same materials, and built with equal care, even though both sides were uncoursed rubble, which is the worst kind of walling.

Where the outside of a wall is an ashlar facing with the inside coursed rubble, the courses of the backing should be as high as possible, and set with thin beds of mortar. In Scotland, where stone abounds, and where, perhaps, as good ashlar facings are constructed as any in Great Britain, the backing of the walls most commonly consists of uncoursed rubble built with very little care. In the North of England, where the ashlar facings of walls are done with less neatness, they are much more particular in the coursing of their backings.

Coursed rubble and brick backings are favourable for the insertion of bond timbers, but in good masonry, wooden bonds should never be in continued lengths, as in case of fire or rot, the wood will perish, and the masonry, being reduced by the breadth of the timbers, will be liable to bend at the place where it was inserted. All the objections urged to the introduction of bond timbers in relation to stonework, apply with equal force to masonry. Hoop-iron is not only available in all kinds of stone walling—including the highly wrought close jointed work—but is invaluable, for it can be used both longitudinally and transversely, as it may in brickwork, whilst it compels the building mason to bring his work up to a true and fair bed as often as the bond is to be laid in it. When it is necessary to have wall timber for the fastening of battens and other internal woodwork, the pieces of timber ought to be built in with the fibres perpendicular to the surface of the wall, or otherwise in unconnected short pieces, not in any case exceeding 9″ in length.

The stones in an ashlar facing generally run from 28″ to 30″ in length, 12″ in height, and 8″ or 9″ in thickness. Although both the upper and lower beds of an ashlar, as well as the vertical joints, should be at right angles to the face of the stone, and the face-bed and vertical joints at right angles to the beds in an ashlar facing, where the stones run nearly of the same thickness, it is of some advantage, in respect of bond, that the back of the stone be inclined to the face, and that all the backs thus inclined should run in the same direction, as this gives a small degree of lap in the setting of the next course, whereas, if the backs were parallel to the fronts, there could be no lap where the stones run of an equal depth in the thickness of the wall. It is of some advantage likewise to select the stones so that a thicker and a thinner one may follow each other alternately. The disposition of the stones in the next (superior) course, should follow the same order as the inferior course, and

every vertical joint should fall as nearly as possible over the middle of the stone below.

Whenever ashlar facing is used with rubble or brick backing, "THOROUGH STONES," as they are technically termed, should be used, their number being proportioned to the length of the course, and every such stone of a superior course should fall in the middle of the two such stones in the course below: this disposition of bonds should be strictly attended to in all long courses. Some masons, in order to show that they have introduced sufficient bonds into their work, choose their bond stones of greater length than the thickness of the wall, and knock or cut off their ends afterwards. This method is far from being a safe one, as the wall is not only liable to be shaken by the force applied to break off the projecting end, but the stone itself is apt to be split.

Bond stones should have their sides parallel, and, of course, be perpendicular to each other, and their horizontal dimension on the face of the work should never be less than the vertical one. All the vertical joints, after receding about ¾" from the face with a close joint, should widen gradually at the back, and thereby form hollow wedgelike figures for the reception of mortar and packing; the adjoining stones should have their beds and vertical joints filled with oil putty from the face to about ¾" inwards, and the remaining part of the bed with well-prepared mortar.

Putty cement will stand longer than most stones, and will even remain prominent when the stone itself is in a state of dilapidation from the influence of the corroding power of the atmosphere. It is true that, in all new-built walls cemented with oil putty, the first appearance of the ashlar work is rather unsightly, owing to the oil of the putty disseminating itself into the adjoining stones, which makes the joints appear dirty and irregular; but the disagreeable effect is soon removed, and, if care has been taken to make the

colour of the putty suitable to that of the stone, the joints will hardly appear, and the whole work will seem one piece. This is the practice in Glasgow, but in London and in Edinburgh fine water putty is used.

The stones used in an ashlar facing are aqueous in their origin, and have thus been formed layer by layer. Care should be taken, therefore, that they should be so worked that the stone may be laid on its NATURAL BED—*i.e.*, in the position in which it lay in the quarry. The ashlars are therefore cut as a section or block might be whilst lying on its surface; for it will be clear that, if the stone were placed on the edge, the separate laminæ of which it is formed would, in the course of time, separate and split off gradually from the front—just as the pages of a book, though previously gummed together, would peel off in time if the book were placed on its edge and subjected to the influence of damp atmosphere.

The limits of this work preclude our entering here more deeply into the subject; the reader is therefore referred for a systematic course of instruction to our "Building Construction," and "Drawing for Stonemasons."

OF PLANS AND WORKING DRAWINGS.

We generally hear the drawings from which a building is to be erected called "plans," in which term the whole set is grouped. This is only, however, correct as far as the word may be considered to mean a scheme or design; but technically it embraces only one series of the necessary drawings, and therefore some little information on the matter may not be considered out of place. It is most important that the amateur should acquire a certain amount of skill in architectural drawing; for if he would work well and economically both as regards time and money, he should, before he commences operations, most carefully make up his mind as to the means he intends to employ in the accomplishment of his wishes, and he can only come to a safe result by scheming out the whole matter on paper. If this is not done, the disappointments will be severe, not only in the impossibility of carrying out the idea, but, even if that were accomplished, in the waste caused by cutting away, altering, changing, modifying, piecing, &c., of all the different parts; and discovering, when the whole is completed, that the structure does not look half as nice as was anticipated—that it is too heavy or too slight; and that if another were built, the present one could be much improved upon.

We often hear people say, "I cannot learn to draw: I have no taste for it;" and it must be admitted that if taste only were concerned, this objection might hold good. But it must be remembered that every one cannot compose poetry, but everybody *can* learn to *write*; and thus, though we do not expect that every gentleman can make an original architectural design, there is no reason why he should not be able to mark out on paper the ideas he wishes to carry out practically, or why he should not be able, by the aid of proper

instruments, to make drawings with sufficient clearness that they may be worked from by the artizans employed. It frequently occurs, too, that gentlemen give instructions to their architects, and express disappointment that their ideas have not been carried out in the designs subsequently submitted to them. This would, however, be obviated if the amateur handed to the professional man drawings, which, however rough, were still sufficiently plain to serve as a basis for the working drawings, the practised eye of the architect would at once detect the points in which the design would fail, and supply the remedy.

The drawings used for building purposes are classed into Plans, Elevations, Sections, and Working Drawings. Plans are divided into: 1. Excavation Plans, which, as the term implies, show how the ground is to be cut or hollowed out for the cellars, and for the walls of the base. 2. The Basement Plans, which show the foundations up to the level of the ground. 3. Floor Plans—often called Chamber Plans—showing the forms of the different floors, and the disposition of the various rooms. There should be a plan for every floor, for although as a rule the upper rooms would be over the lower ones, this is not always the case, circumstances rendering a different division of the area on some of the floors, as in the case when the attic floor is to contain more rooms than the ground floor—the space being divided by partitions, in addition to the walls, carried up from below. Then we have—4. Roof Plans, which show how the building is to be covered, where the ridges and valleys are to fall, and the arrangements made for conveying the water to the apertures through which it is to be carried off, the disposition of the slates, and the plumber's work. The plans, therefore, are horizontal views of the building—such as would be obtained if the spectator were seated in a balloon looking directly down on it. In the first place, he would see the roof and tops of the chimneys, skylights, &c.; but, supposing

an enormous knife to pass horizontally and cut off, and remove the whole upper portion of the building just under the roof, the observer would see the top edges of the external and internal walls, the partitions, and the staircase leading from the floor immediately below. If the knife were again to pass immediately under the ceiling of the next floor, the entire arrangements of the rooms and stairs appertaining would then appear; and this would go on as each portion of the building were lifted off. It is usual to represent the roof as if some of the slates had been removed, so that the arrangement of the roof timbers may be shown

Elevations, as their name implies, show the heights, but they show the widths also: they are, in fact, geometrical drawings of the building. We use the term "geometrical" in opposition to "perspective views:" the first are simply measured drawings, where every door, window, balcony, and moulding is drawn to accurate scale *as they are*, whilst, in perspective views, artistic pictures are given, showing the whole as it *appears* from different points of view. Thus, in an elevation, all the lines are represented (to scale) of their correct sizes; but, in a perspective view, the distant lines, though known to be of the same length as those in front, are rendered shorter, and lines known to be horizontal, become oblique by convergence to the point of sight. Under these circumstances, it will at once be understood that there must be as many elevations as there are visible sides of the building: thus we speak of "front elevation," "back elevation," &c., &c.

The third kind of drawings are called "Sections," which, as the name implies, represent cuttings. Thus it has been shown that the plans are, as it were, horizontal sections; but vertical sections are also required to show the heights of the different floors and their construction, the position of the staircases, the disposition of the roof-timbers, and other particulars: thus there are *longitudinal* and

transverse sections. Now, if a knife were really passed down through a house, it would cut through the walls, &c., and leave other parts untouched: of course this refers to cuttings not only of the whole house, but of portions of it; in order, therefore, to distinguish the one from the other, it is usual to rule lines at an angle of 45° over the parts which represent sections. In coloured drawings this is not always done, but the sectional parts are tinted with a darker colour than the others.

Detailed or Working Drawings are those from which the various artizans are to make the separate parts, and they must therefore be exact in every particular: they are, of course, required to be on a larger scale than the other drawings; some portions are even drawn to the full size, their precise measurements being marked on them.

All the drawings are, in fact, figured, but the measurements are representative, or, as it is termed, drawn "to scale;" thus, some drawings are done to the scale of 1″ to one foot, or one-twelfth of the real size, or one-tenth of an inch to the foot, in which case the drawing is the one-hundred-and-twentieth of the true size.

In order that the amateur may be enabled to append a scale to each drawing, by which much trouble is saved, the following instructions are given.

Draw a line, indefinite in length, and set off the unit of a foot. Let us suppose we require a scale of ¼″ to the foot, which would be a scale of $\frac{1}{48}$.″ Set off several of these, numbering the beginning of the line 0, the first point 1, the next 2, &c., up to 10; next to this mark 5′ in one, and so on. Divide one of the feet into halves, representing 6″, another into quarters, representing 3″; and, if possible, divide these again into three, so that inches may be measured by the scale. If accurate measurement of inches is required, however, a larger scale will be necessary. In this way scales of $\frac{1}{120}$ or $\frac{1}{10}$ of an inch to the

foot, of $\frac{1}{144}$ or $\frac{1}{12}$ of an inch to the foot, of $\frac{1}{96}$ or $\frac{1}{8}''$ to the foot, or any other scale, may be drawn.

This plan will be found by far more convenient than to measure the number of feet of the scale from the usual 12″ or 2′ rule, which is divided into inches, again divided into eighths or tenths, not numbered. Scales of every kind are, however, sold, and will be found very useful; or a set of the most generally used scales may be made on strips of cardboard, and kept in the mathematical instrument case. But in spite of all these conveniences, we advise the amateur to add a scale to every drawing, so that the size of any part may be readily ascertained by the compass. The power of constructing such scales is very easily attained, and any little trouble will be very well repaid.

The first necessaries for drawing are, of course, paper and pencils. For general drawings required for practical purposes, a good strong cartridge will be found to answer very well. For finer work, drawing-papers of better quality will be required: these are made in various qualities, sizes, and thicknesses, or "weights." For outline drawings the kind called "hotpresssed" should be used; but where the drawings are to be coloured, the rougher kind is necessary: this is called "plain" or *not* "hotpressed." The following are the names and dimensions of the various sizes of drawing-papers:

Demy . . .	20″ × 15″	Columbia . .	34″ × 23″
Medium . .	22″ „ 17″	Atlas . . .	33″ „ 26″
Royal . . .	24″ „ 19″	Double Elephant	40″ „ 26″
Super-Royal .	27″ „ 19″	Antiquarian .	52″ „ 31″
Imperial . .	30″ „ 21″	Double Imperial .	60″ „ 42″
Elephant . .	28″ „ 23″	Emperor . .	68″ „ 48″

The size most generally used is that called "imperial," either in whole sheets or cut into halves or quarters, which is by far better than cutting it into odd pieces.

Drawing-pencils are of various qualities and degrees of hardness. The kinds most useful for our present purposes are those marked H or HH and HB. The first means "hard," the next "harder," and the third "hard and black,"—a medium pencil, in fact, useful for rough sketches and other general purposes. The degrees of hardness are shown by the number of the letter H, whilst the addition of the letter B shows the increase in colour and softness. There are also carpenters' pencils, which are larger than others, the lead thicker and oblong in sections: these will be found very useful in marking out forms on timber.

It is necessary that the paper on which a drawing is to be made should be fastened to a drawing-board; and to make such an appliance may perhaps be one of the first efforts of the amateur carpenter. In its simplest form it consists of wood about ¾″ thick, glued up to the required width, and clamped by cross-pieces at the ends; these are united to the board by the plough-and-tongue joint, or mitre-clamped, as already described. A good board may also be made by screwing rabbets at the back, the screws entering on the edge of the rabbets or ledges. In all these cases, unless the wood be thoroughly seasoned, the board will warp, twist, and split—and therefore the greatest care in choosing the material must be exercised. In clamped boards, as the fibres of the wood contract, the board itself becomes narrower than it was originally, but the clamps—the length of which is opposed to the breadth of the board—do not contract in the same direction, and the consequence is that their ends project beyond the edge of the board; and thus "shooting" or planing becomes necessary until the board is thoroughly seasoned. In order to allow for the expansion and contraction of the wood, grooves may be cut at the back, having their sides slanting inward; and into these the rabbets cut so as to be broader at the one edge than at the other may be driven. These should not be glued, but merely attached by

one screw: in this case the ends of the boards are not to be clamped. Drawing-boards are also made on the frame and panel principle—that is, a frame properly mortised at the angles is made, the inner edge being grooved; a panel is then made with a rebated edge, which is inserted into the grooves of the frame, the surface of the board thus becoming flush with the frame. This principle is further developed in what are called "shifting panel" drawing-boards.

In these the panel is separate from the frame; the paper is cut about an inch larger all round, and when it has been well moistened it is wrapped over the panel, which is then pressed into the frame and secured by two rabbets which work in grooves at the back. When the paper has dried it is found to be perfectly flat, and the necessity for holding it on by any other means is avoided.

This result is obtained with the simpler boards by "stretching" the paper—an operation which is performed in the following manner: Having cut the paper so that it may be slightly smaller than the board, turn up the edges to about the extent of ½" all round; turn the sheet over and wet the back with a sponge, allowing the water to soak in for a few moments, but observing that it must be spread equally, and that the surface must be kept equally moist during this time. Now, taking hold of the sheet by the edges, turn it over so that the wet side may touch the board, at the same time placing it in its proper position. With a brush apply strong paste or glue to the upturned edges, and, as quickly as possible, press them down on the board at the same time, placing the thumbs of both hands under the edge of the board, and the eight fingers on the edge of the paper; draw the latter outward, repeating this operation on all the sides until the paper is stretched nearly flat. The edge is then to be rubbed or burnished down with the handle of a penknife, or other smooth piece of bone or wood. The board should be left in a horizontal position whilst the paper is drying, and if there should remain any very large

elevations or "blisters" which do not seem to decrease, these may be punctured with a needle, so that the air under them may escape. Should this plan fail, the surface of the paper must be moistened all over with a sponge, and the edges drawn out again; this is, however, very troublesome, and therefore care should be taken in the first operation, so that the second may not be necessary. Paste is better than glue for stretching paper, as it does not set so rapidly, and therefore allows of the paper being drawn out more efficiently than otherwise.

It is only necessary to stretch paper when the drawing is likely to occupy some length of time, or when any large portions of it are to be coloured. For working drawings, and such as are only to be a short time in hand, it is generally found sufficient to fasten down the paper by means of drawing-pins, which are simply brass-headed nails, the length of which is only about ¼", whilst the head is ⅜", ½", or even more, in diameter. The objection to these is that they impede the action of the T-square near the edge of the paper; but this may be avoided by removing them to another part for the time.

Drawing-boards should be made to agree with the regular sizes of the papers, about ½" being allowed all round for margin. The following three sizes will be found very useful:

Whole sheet imperial, 31" × 22"; half-sheet imperial, 22" × 16", and quarter imperial, 16" × 12½". These are kept in stock by artists' colourmen; and, unless the amateur feels quite competent to make them, the best plan is to purchase them ready made, as he will then be assured that they are well seasoned.

The next indispensable adjunct is the T-square, which should be made with the utmost accuracy. The size should correspond with that of the drawing-board with which it is to be used. The best form of T-square is that in which the blade is screwed across the top of the stock or end-piece—not mortised into it. In the latter

kind, the action of the set square is impeded by the cross-piece when some inches from the edge of the paper, whilst, in the former, it passes over it. In the larger sizes of T-squares, the blade should be broader at its insertion than at its extremity.

The T-square should be used on the left-hand side of the drawing-board, and should, as a rule, be employed for lines at right angles to that side; lines at right angles again to these should be obtained by means of the set square, one side of which should be carefully guided along the edge of the T-square, the other will then be perpendicular to it. The T-square should not be used on two adjacent sides of the board, for these, owing to the possible shrinking of the longer side, and the consequent projection of the ends of the clamps, may not be at right angles, and the lines drawn would not be perpendicular to each other.

Set squares are made of box, pear, ebony, other woods, or of vulcanite. They are in the form of right-angled triangles, the opposite angles being of various degrees. Two of these are necessary, the one having two angles of 45° and one of 90°, the other having angles of 30°, 60°, and 90°.

When several lines are required to be drawn parallel to each other, one set square should be placed against the original line, and the other immediately under the first: as the upper square slides against the lower one, the edge which was placed next to the line will be parallel to it, however much it may be moved up or down.

We now proceed to describe the mathematical instruments which will be found most useful, and foremost among these is the Compass. The form of this instrument is too well known to need much description. The one used for drawing purposes has three movable legs: 1st, the steel point: when this is in its place the compass is used for measuring distances, both points being alike. 2nd. The pencil leg, used in drawing circles and arcs. This is furnished with a socket,

in which a piece of pencil is secured by a screw: this pencil should, each time it has been pointed, be corrected as to its position, which should be such that the two points of the compass should be precisely equal. 3rd. The inking-leg, which consists of two nibs placed flat against each other, and, ink being placed between them, circles or arcs are described, the thickness of the line being regulated by widening or narrowing the distance between the nibs.

These legs fit into the compass either by a triangular tenon, which fits into a similarly shaped hole in the end of the shorter portion of the compass, where it is held by a screw, or by a slip-joint,—which is to be preferred to the former as being more steady and not so likely to become shaky through use. This joint is formed in the following manner: The end of the body of the compass is pierced by a hole running about ½″ or ¾″ up it, and this has a slit on the upper side of the compass. The movable leg has a tenon or shank corresponding to the hole, and on this there is a projecting rim or ledge which, as the leg is pressed into the hole, runs in the slit—thus effectually preventing any lateral motion; the leg is thus held as by springs.

In drawing circles in ink, the inking-leg should be bent at the joint so that the part containing the ink may be upright,—both nibs then touching the paper; where this is not done the line will be ragged on its outer edge and unequal in thickness, from the circumstance that the outer nib has not been brought into action. It is advisable to bend the pencil-leg in the same manner, as otherwise the side instead of the point of the leg will be used, the line will rapidly become thick, and accuracy will be lost.

When circles are required of a larger size than can be drawn with the compass, a lengthening bar is used. This has a tenon or shank at one end by which it fits into the compass, and a hole at the other into which the tenon of the movable leg may be fitted: the one leg of the compass is thus much increased in length. When the compass

thus fitted is used, the original leg should be held as nearly upright as possible, the lengthening bar extended, and the movable leg at its extremity being bent at the joint so that it may also be upright.

The steel point of the compass should be kept rounded,—not triangular in form; and the power should be obtained as soon as possible of pressing very lightly on it, so that the paper may not be pierced at the centre of the circle, by which much accuracy would be lost.

For smaller circles, the Bow Pencil and Bow Pen are used. These are simply compasses of much smaller size than those usually employed: they differ, however, in form, as, instead of ending in a joint, they have a small handle, either of metal or ivory, so that they may be very conveniently held and twirled between the forefinger and thumb. In the single-jointed bows, the legs do not bend, but, in the double-jointed sort, each leg has an extra joint, so that they may be bent upright for the purpose already explained.

For extremely refined purposes, still smaller instruments are used, in which the two legs are not united by a screw, but by a spring: these are called "spring bows," and are usually sold in sets, comprising the steel, the pencil, and the pen-pointed. The alteration of distance between the points in these is effected by a screw acting on a small rod fixed to the one and passing through the other leg.

When it is required to measure distances on the drawing, or to transfer measurements from the rule to the drawing, or to divide spaces, a pair of compasses, not quite so large as the usual pair, and having two steel legs—not changeable—is used: this is called the "dividers."

Every one knows the annoyance which frequently occurs in dividing a space when we get the parts nearly and *very* nearly—almost but not quite—right. We alter our compass, but we alter it too much, or not enough, because it is often almost impossible to move

the joint so little as to effect our purpose. This difficulty is obviated by the "hair dividers," in which the one leg, after the proper distance has been nearly obtained, can be altered by means of a spring in an almost imperceptible degree, and thus the most refined difference is made.

All the instruments thus described would, however, prove useless for drawing very large circles, and, for these, the "beam compass" is used. The principle of this is very easily explained. Supposing it were required to mark out on a floor an arc of a circle of 14′ 0″ diameter, it could easily be done by using a rod of wood a little more than 7′ 0″ long, boring two holes at exactly 7′ 0″ apart, passing a nail through the one into the point at which the centre of the circle is to be situated, and inserting a piece of chalk or pencil into the other; as this is moved round, it would of course trace the required circle.

The "beam compass" is a simple application of this principle. It consists of a rod of wood, which should be very well seasoned, upon this two metal blocks slide easily, and in such a manner that they may be secured at any part by clamping-screws. These are called the "beam-heads," and upon each of them a socket is constructed—in the one case to bear a plain point, and in the other a pen or pencil-leg, which traces the required circle or arc, the plain point being held in its place.

It is clear that the wooden rods used for beam compasses such as those described, could not be contained in mathematical instrument cases, and in these the "tubular beam compass" is placed. In these the beam is made up of pieces of different-sized tubing, which work accurately in each other, like the parts of a telescope, and are secured at the required lengths by clamping-screws only. One of the beam-heads is made to slide on the outer or larger tube; this head holds the steel point for the central pillar, the fixed head at the end of the smallest tube holds the pencil or inking-leg.

The "draw-pen," or, as it is often called, the "inking-pen," is used for inking the lines in a drawing. Like the inking leg of the compass, it consists of two steel nibs, or cheeks, opposed to each other, the thickness of the line being regulated by the distance between these, which may be altered by a screw: the pen is fixed in an ivory or ebony handle. The better kind of pens are made so that the nib moving on a joint, may be opened when the screw has been taken out: by this plan it is easier to keep the pen thoroughly clean, which is a matter of the utmost importance in drawing, as of course an atom of grit or dried ink coming between the nibs, impedes the flow of the ink, and causes irregularity in the thickness of the line. The ink should be put into the draw-pen by means of a camel's-hair brush; the pen should not be dipped in the ink, as it might touch the dry colour at the side of the slab or saucer, or take up any floating particle. Both sides of the nibs should be wiped on a piece of rag or paper at the side of the slab after each application of ink, and the pen should be tried on the edge before the work is begun or continued. The pen should be held as nearly upright as possible, the middle finger resting on the screw.

When a drawing has been outlined in pencil, and is to be inked, the india-rubber must be passed several times lightly over the paper, so that all loose particles of lead may be removed, and merely a faint trace of the form left. If the paper should seem at all greasy, a very small quantity of prepared ox-gall should be mixed with the ink.

Indian ink should be employed for drawing purposes. The instruments should never be touched by common writing ink, which corrodes and otherwise damages them. The Indian ink should be rubbed in a saucer, and when it is found to be of the proper consistency, it should be allowed to stand for a few moments, so that any grit or pieces which may have chipped off the stick may settle down, after which the clear colour may be poured into another saucer or slab.

When several copies of a drawing are required, it is usual to execute them by means of tracing. This is done by placing tracing-paper over them, and repeating the lines which are visible through the transparent tracing-paper: these tracings are often mounted on paper to be used by the workmen, or they may be executed on tracing-cloth, which is so prepared as to be perfectly transparent, and to receive colour as well as paper. This may be purchased by the yard or in the piece; thus it may be obtained 18″ wide, in pieces of 40 yards, and in various widths up to 32″ in pieces of 52 yards.

The drawings having then been thus far completed, it is necessary to colour them: we say *necessary*, because we are not now speaking of the art of building or painting as matters of taste, in which forms and colours may be adopted which please the fancy or convey a sentiment. We have here to treat art in its practical aspect, and our present purpose is to show the amateur how to colour his drawings, so that he need not write at the side of any part "this is to be made of wood" or "this is brickwork;" for be it known, that a set of technical colours has been generally agreed on, each of which implies a particular material. All builders and engineers understand these, and when the time shall come—and do we not all believe that "there's a good time coming"?—when proper technical education is given to our working men, every artizan will appreciate form and colour as additional languages, and will possess the power of working from, and of making, an accurate working drawing.

We give here a list of the technical colours as generally adopted in architectural drawing, and shall also append a few hints on the method of colouring drawings:

Materials		*Colours.*
Brickwork in plan and sections	*represented by*	Crimson lake.
Brickwork in elevation . .	"	Crimson lake, mixed with Burnt Sienna.
Pine and other lighter woods .	"	Raw Sienna.

Materials		*Colours.*
Oak or Teak	*represented by*	Vandyke brown.
Mahogany	„	Burnt Sienna, with Crimson Lake, and darker markings.
Stone generally	„	Yellow Ochre, or Pale Sepia.
Granite	„	Indian ink, pale.
Clay, or Earth	„	Burnt Umber.
Slate	„	Indigo and Lake.
Lead	„	Pale Indigo, tinged with Indian ink.
Concrete	„	Sepia, with darker markings.
Wrought Iron	„	Indigo.
Cast Iron	„	Neutral tint.
Steel	„	Pale Indigo and Lake.
Brass	„	Gamboge.
Copper	„	Lake.
Zinc	„	Pale Indigo, tinged with black.

It would be out of place here to enter at length into the principles of water-colour painting, our present object being merely to give a few instructions as to the method of colouring architectural and working drawings in an efficient manner, and this power may be acquired by any one who will give a small amount of attention, and who will devote a little time to practising the manipulation.

Water-colours are sold in three forms: in cakes—moist, in oblong pans—and in tubes; in addition to which, colours may be obtained in powders, to be mixed with gum, water, or other vehicles. These do not, however, appertain to our present subject.

The first two kinds are those which are best adapted for tinting architectural drawings, and the difference consists mainly in the method of placing the colours on the palette: the cakes are rubbed, whilst the colour is taken with the brush from the moist pans, and then deposited on the slab. The choice is thus a matter of taste; but there is no doubt that cakes are rather more manageable for beginners, and the colours are kept cleaner, as the surface of the moist pigments is very likely to become tinged with the colour of the one next to it, or brought to it by the brush; whilst, on the other hand, a much greater

body of colour may be obtained from the moist colours, whether in pans or tubes, than from the cakes.

In commencing to mix a colour, take care in the first place that the slab or saucer is perfectly free from dust, which would sadly interfere with the clearness of the tint. Do not dip the cake into the water, by which means the end of it becomes soaked, and pieces chip off whilst rubbing, but place a brushful or two of water on the slab, and rub the cake in it; when a sufficient quantity has been rubbed, it may be thinned by the addition of water, taking care that the whole is well stirred. When the cakes have been used, the ends should be slightly rubbed on a piece of paper, so that the extraneous colour may be removed; they should then be placed on their opposite edge to dry before being restored to their places.

When it is desired to mix two colours so as to form a third, do not dip the second cake in the colour already obtained from the first, but rub each separately, and mix them with a brush: unless this be done, the ends of the cakes will become soiled, and the purity of the colour will be deteriorated.

The colour should not be used direct from the moist pans unless the full depth of tone be desired, for the moist colours yield very quickly to the solvent power of the water, and a brushful of colour, which is much deeper in tone than is as a rule necessary for tinting a drawing, is obtained rapidly from them, requiring admixture with a quantity of water; and further, each brushful will be darker than the previous one, as more of the moist colour will have become dissolved. The best method of using the moist colours for flat washing is as follows: Take the pan containing the colour required, out of its place in the box, and holding it slantingly over the slab, wash over it with a brush full of water, allowing the colour thus removed to run down on the slab: this is better than taking a quantity of thick colour in the brush, as in that case it is often found that

some particles remain in the brush and work out whilst a wash is being laid, thus destroying the flatness of the tint. On the whole, although many artists find moist colours preferable to the cakes for absolute water-colour painting, we cannot but think that the cakes are the best adapted for the purpose we have in view.

When a large surface is to be covered with a flat tint, the colour should be mixed and allowed to stand a few moments, after which it should be poured off into another slab. The paper should be placed rather slantingly, and the wash should be commenced at the top, working from left to right as quickly as possible, at the same time taking care not to pass over the outlines. The brush should be the largest which under the circumstances can be used. It is hopeless to attempt to obtain a flat tint with a small brush, whilst very fine work may be done with a large one, if once the power of using it properly shall have been acquired. When a brushful of colour has been taken, the brush should be trailed along on a piece of waste paper, at the same time twirling it round, by which means it will become pointed, so that it may be used against the outline of the part to be coloured. Care should be taken not to allow a pool to collect at any one part, but the mass of colour should be carried along by the brush; and at the end, should there still be a superfluity, it should be taken up by the brush, from which it may be discharged against the edge of the water-glass or slab, or it may be dipped up with a piece of blotting-paper. Should the whole wash be found to be too dark, it may be entirely removed with a sponge and clean water; but care must be taken not to rub the surface of the paper so that it may be spoilt for the repetition of the tint. If the wash should be found defective or unequal in any part, it must not be touched until dry, as dabbling about in the wet colour will only make it worse; if any spot be found lighter than the rest, it may when dry be tinted separately, or touched up with the point of

the brush; this is called "stippling;" after which a thin wash may be carried over the whole. Should any part be found too dark, it may be washed down by a stiff brush containing very little water, or it may be much improved by india-rubber or stale bread-crumbs. Do not begin to colour any one part with another tint until the portion adjoining is perfectly dry, as there will be the risk, or rather the certainty, of the colours flowing into each other.

Do not attempt to imitate the exact graining of the woods represented. A few touches of a darker colour on the original wash, in order to show the general direction of the fibre, is all that is admissible in architectural drawing.

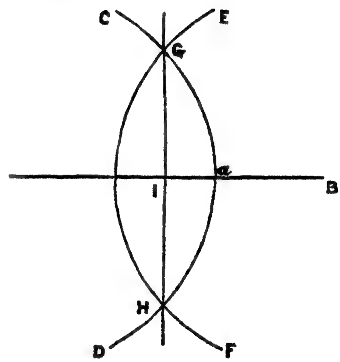
It will improve the appearance of a drawing to repeat the ink-lines after the colouring has been done, by which means the work is brightened up; some portion of the ink having, of course, been washed away in tinting. When it is intended to do this, the ink originally used should be very pale, so that any of it that has been washed off may not appear like a smear or fringe around the darker line subsequently drawn. For heavy lines, such as the darker ones called "shade-lines," this plan should always be adopted.

In tinting drawings, bear in mind that if the colour should when dry, be found too light, it is easily remedied by carrying a second wash over it, but that it is very difficult to lighten the tint if too dark; the work, in fact, seldom looks bright and fresh after this has been done. It is therefore advisable, that beginners should keep the colour as light as possible, until the judgment is sufficiently formed to enable them at once to apply the exact tint.

In order to mark out with correctness the necessary forms required in carpentry or other branches of building, and to make working drawings with accuracy, a certain amount of knowledge of Practical Geometry is indispensable; the following constructions are therefore appended; whilst for an enlarged course the reader is referred to "Linear Drawing," by the Author.

To divide the line A B into two equal parts (Fig. 132).

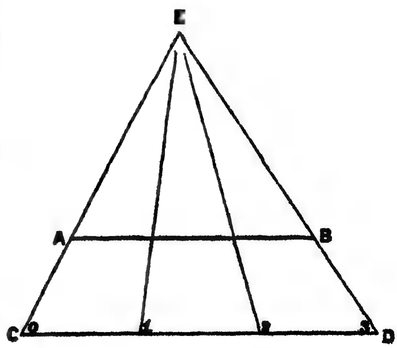
With A and B, in turn, as centres, and with a radius obviously larger than half the line, as A *a*, describe the arcs C D and E F intersecting in G and H. Join G H. Then the point, I, where E F meets A B, is the centre of the line. By extending this process and bisecting each half again, the line can be divided into four equal parts.



To divide the line A B into three, or any number of equal parts (Fig. 133).

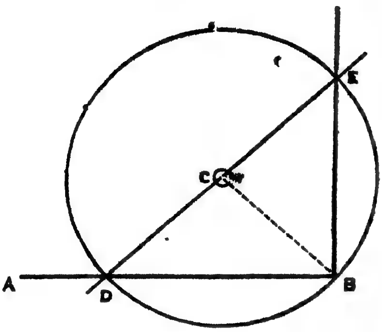
Draw a line, C D, parallel to A B. The line, C D, may be any length—that is, it may be drawn indefinitely for the present.

From C, set off along this line the number of parts into which the line, A B, is to be divided. These parts may be any convenient size, but must be equal. Draw lines from the last point set off on C D, to B, and from C to A, producing both until they meet in E.



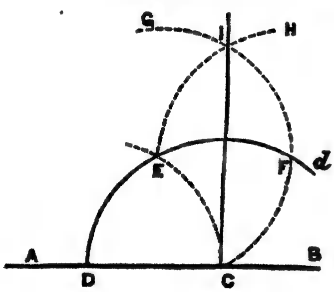
From each of the points set off, as 1 and 2, draw lines to the point E, which, passing through A B, will divide it into the required number of equal parts.

To erect a perpendicular at the end of the line A B (Fig. 134).



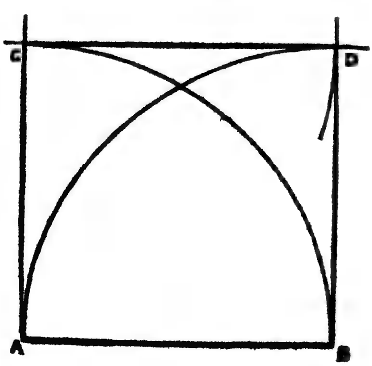
From any point above the line, as C, with radius C B, draw an arc, cutting A B in D. From D, draw a line passing through C, and cutting the arc in E. Draw a line through E to B, which will be perpendicular to A B. "Perpendicular" is a term which must be used *relatively to another*, and does not imply that the line spoken of is *upright*. Thus, the sides of a square are perpendicular to each other, even though the square may lie in a horizontal position. A *vertical* line is one that is upright, as a line held by one end with a weight at the other.

The same by another method (Fig. 135).



Let it be required to erect a perpendicular from the point C, which may be at the end, or at any other part of a line, A B.
From C, with any radius, draw an arc, D *d*.
From D, with radius C D, draw an arc cutting D *d* in E.
From E, with the same radius, describe the arc, C G, cutting the arc D *d* in F.
From F, with the same radius, draw the arc E H, cutting the arc F G in I.
Draw a line through the point I, to meet C, and this line will be the perpendicular required.

To construct a square on the given line A B (Fig. 136).



Erect a perpendicular at A.
Make the perpendicular, A C, equal in length to A B.
This is best done by using A as a centre, and A B as radius, then describing the arc, in this case a quadrant, A C, which will cut off the perpendicular at the required length.
From B, with radius A B, describe an arc; and from C, with same radius, describe another arc cutting the former one in D.
Draw the lines C D and D B.
A B C D will then form a square.

The following useful hints are quoted from the late Professor Bradley's excellent work on "Practical Geometry":

"Builders make use of a method of setting off a line at right angles to a given one, which certainly deserves notice. Suppose the front of a house is indicated by a string stretched between two pegs stuck in the ground, and the side walls are required to be marked out by the same means, at right angles to the former; the corner of the building being marked by a peg. Three yards are carefully measured off along the string, and another peg fixed in the line. Two other strings, one 4 yards and the other 5 yards long, are fixed, the former to the peg indicating the corner, and the other to that at the termination of the three yards; these strings being stretched tight, and their ends brought carefully together, the point where they meet will be in a line perpendicular to the first string. If the building be very large, and greater nicety is required, 6, 8, 10 yards, or any equal multiples of 3, 4, 5, may be used."

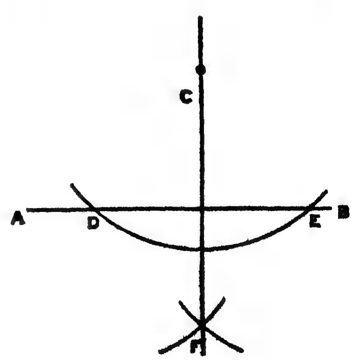
"Draughtsmen sometimes make use of the same mode on paper, by taking 5, 4, 3, or any multiples of them, from any scale of equal parts, the larger number being always the hypothenuse of a right-angled triangle, of which the sides are of the length indicated by the two other numbers."

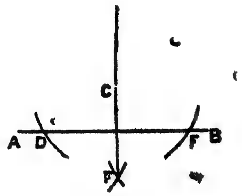
To draw a line perpendicular to A B, from a point lying away from the line, as C (Fig. 137).

From C, with a radius rather shorter than from C to B, draw an arc cutting A B in the two points, D and E.

From D and E, with any radius, draw arcs cutting each other in F.

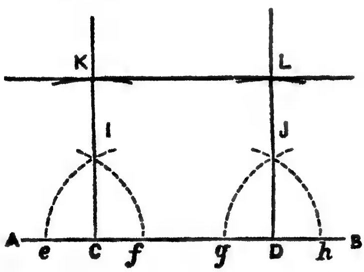
Draw C F, which will be perpendicular to A B.





This mode would apply if the point, C, were *under* the line, or if A B were placed obliquely, &c., as in Fig. 138.

To draw a line parallel to A B, and at a given distance from it (Fig. 139).



Mark any two points on the line, viz., C and D.

Set off equal distances, *e f* and *g h*, on each side of C and D.

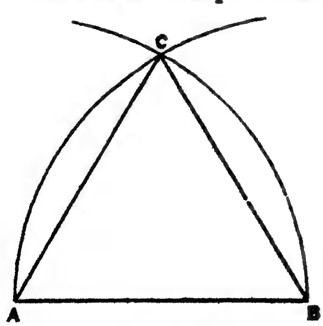
From *e f g h* with any radius, describe arcs cutting each other in I and J.

Draw lines from I and J through C and D.

On these perpendiculars set off from C and D the required distance between the parallels, viz., C K, and D L.

Draw the line K L, which will be the required parallel.

To construct an Equilateral Triangle on the given line A B (Fig. 140).



From A, with radius A B, describe an arc.

From B, with the same radius, describe a corresponding arc cutting the former one in C.

Lines joining A C and B C will complete the triangle, which will be *equilateral*—that is, all its sides will be equal.

A triangle having only two of its sides equal, is called an Isosceles Triangle.

When all three sides are of unequal length, the figure is called a Scalene Triangle.

In a Right-Angled Triangle, one of the angles is a right angle. A right-angled triangle may be either Isosceles or Scalene.

The longest side of a right-angled triangle, viz., the side opposite to the right angle, viz., F, is called the *Hypothenuse.*

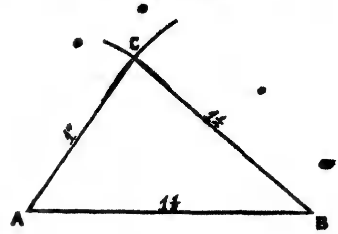
To construct a Triangle of given dimensions (Fig. 141). Let it be required that the sides of the triangle should be $1\frac{1}{2}''$, $1\frac{1}{4}''$, and $1''$.

Make A B $1\frac{1}{2}''$ long.

From B, with a radius of $1\frac{1}{4}''$, describe an arc.

From A, with a radius of $1''$, describe an arc cutting the former one in C.

Draw A C and B C, which will complete the triangle of the required dimensions.

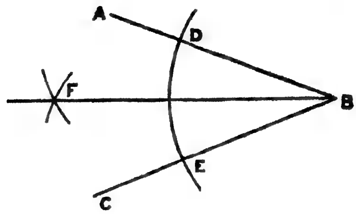


To Bisect an Angle, A B C (Fig. 142).

From B, with any radius, describe an arc cutting the lines B A and B C, in D and E.

From D and E, with any radius, describe arcs cutting each other in F.

Draw B F, which will bisect the angle.

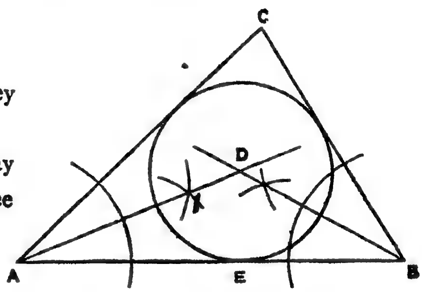


To Inscribe a Circle in the Triangle A B C (Fig. 143).

Bisect any two of the angles.

Produce the bisecting lines until they meet in D.

From D, with the radius D E, a circle may be described which will touch all three *sides* of the triangle.



To Draw a Circle through three points, however they may be placed (provided they are not in an absolutely straight line) (Fig. 144).

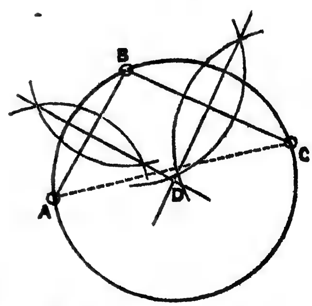
Let A B and C be the three given points.

Join A B and B C.

Bisect A B and B C, and produce the bisecting lines until they cut each other in the point D.

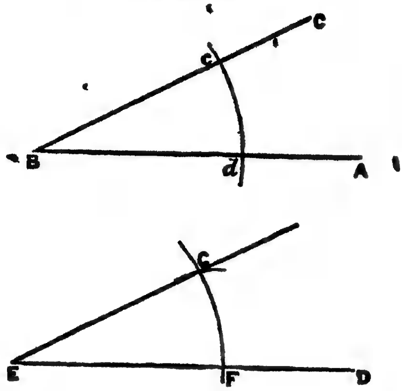
Then D will be equally distant from each of the three points.

Therefore from D, with radius, D A, D B, or D C, a circle may be drawn which will pass through the three given points.



It will be evident that if A and C were joined, the figure would be a triangle, and thus this problem serves also for describing a circle which shall touch the three *angles* of a triangle.

To Construct on the given line, D E, an Angle similar to the angle A B C (Fig. 145).



From B, with any radius, describe an arc cutting the sides of the angle in *c d.*

From E, with the same radius, describe an arc cutting E D in F.

Measure the length from point *c* to *d.*

Mark off the same on the arc from F, viz., to point G.

Draw a line from E through G.

The angle F E G will be equal to A B C.

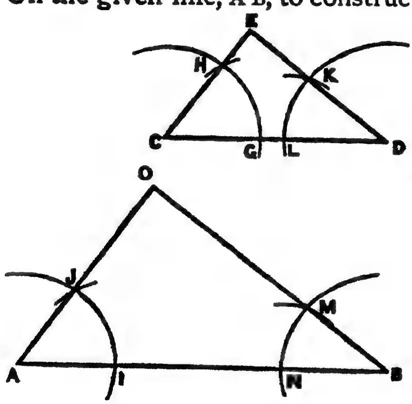
When a figure is said to be *similar* to another, it means that it is to be the same *shape.*

When it is said to be *equal,* it means that it is to be of the same area, that is, to contain precisely the same *space.*

A figure may be *equal* to another without being *similar* in shape, and *similar* without being *equal.*

Similar and equal, signifies being of both the same *size and shape* as another figure.

On the given line, A B, to construct a Triangle similar to C D E (Fig. 146).

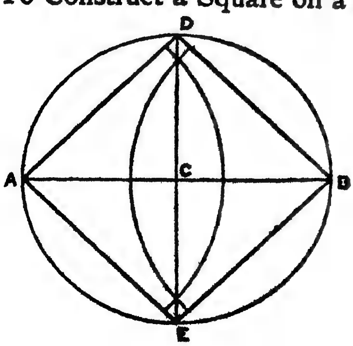


At A, construct an angle similar to the angle H C G, viz., J A I.

At B, construct an angle similar to the angle K D L, viz., M B N.

Produce the lines, A J and B M, until they meet in O, which will complete the triangle required.

To Construct a Square on a given Diagonal, A B (Fig. 147).

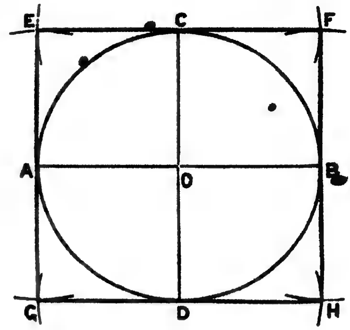


Bisect the diagonal, A B, in the point C.

From C, with radius C A, describe a circle, cutting the bisecting line in D and E.

Draw A D, D B, B E, E A, which will complete the square on the given diagonal, A B.

To Describe a Square about a Circle (Fig. 148).



Draw two diameters at right angles to each other.

From A and C, with radius equal to the radius of the circle, O A, describe arcs cutting each other in E.

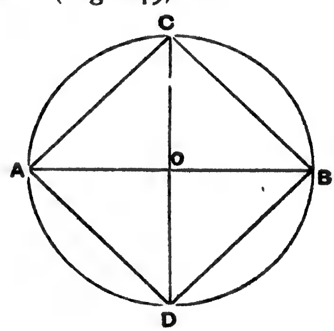
From C and B, with same radius, describe arcs cutting each other in F.

From A and D, with same radius, describe arcs cutting each other in G.

From D and B, describe arcs cutting each other in H.

Draw E F, F H, H G, and G E, which will complete the square about the circle.

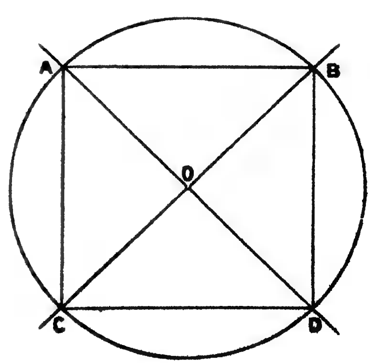
To Describe a Circle about the Square, A B C D (Fig. 149).



Draw the diagonals, A B and D C.

From their intersection, O, with radius, O A, or O B, O C, O D, describe the circle touching the four angles of the square.

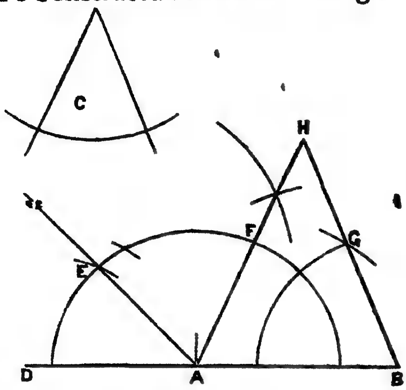
To Inscribe a Square in a Circle (Fig. 150).



Find the centre of the circle, and draw two diameters at right angles to each other.

From their extremities draw lines A B C D, which will form the square in the circle.

To Construct an Isosceles Triangle when the vertical angle is given (Fig. 151)



Let A B be the given base, and C the given vertical angle.

Produce A B towards D

At A, construct the angle D A E, similar to the angle C (the given vertical angle).

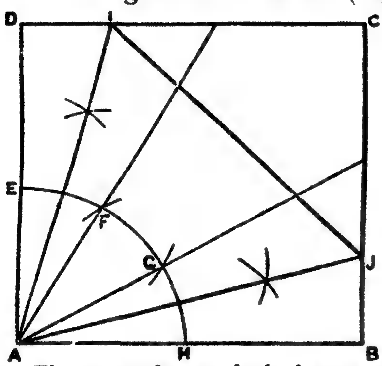
Bisect the angle E A B, in F

At B construct an angle similar to the angle F A B, viz, the angle G B A

Produce A F and B G until they meet in H

Then the vertical angle at H will be similar to the given angle C.

Within the given Square, A B C D, to inscribe the largest Equilateral Triangle it will contain (Fig 152)



From A, with any radius, draw the quadrant E H

From H, with radius A H, cut the quadrant in F

From F, with the same radius, cut the quadrant in G

Draw A F and A G, which will *trisect the right angle*

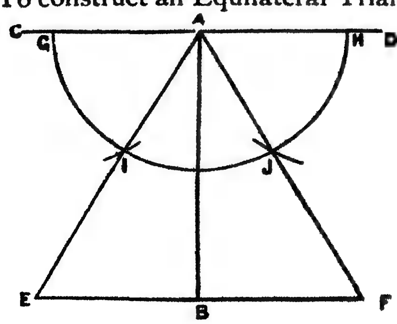
Bisect the angles, E A F and G A H, by the lines A I and A J

Join I J

Then A I J is the largest Equilateral Triangle that can be contained in the square A B C D.

The principle on which this construction is based is that, as the angle of the Square is 90° and that of the Equilateral Triangle is 60°, there is an overplus of 30°. If, then, the two outer angles (E A F and G A H), which are each 30°, are bisected, and half of each added to the angle F A G (30°), an angle of 60° is obtained centrally placed, leaving 15° on each side. It will be seen that the sides of the equilateral triangle are larger than those of the containing square.

To construct an Equilateral Triangle of the given altitude A B (Fig 153)



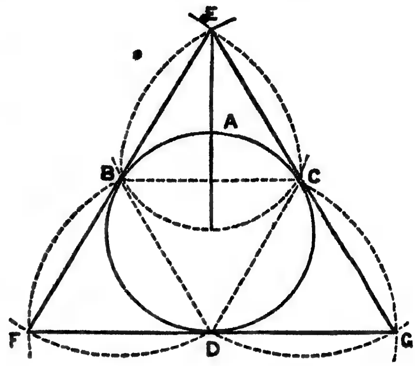
At A and B draw lines, C D and E F, at right angles to A B

From A, with any radius, describe the semicircle G H.

From G and H, with radius A G, cut the semicircle in I and J

From A, draw lines through I and J, which, meeting E F, will complete the Equilateral Triangle

To construct an Equilateral Triangle about a given circle (Fig. 154).



From any point in the circumference, as A, with a radius equal to that of the circle, describe an arc cutting the periphery or circumference of the circle in B and C.

From B and C, with radius B C, cut the periphery in D.

(It will be seen that if B C, B D, and D C are joined, an Equilateral Triangle will be inscribed in the circle.)

From B and C, with radius B C, describe arcs cutting each other in E.

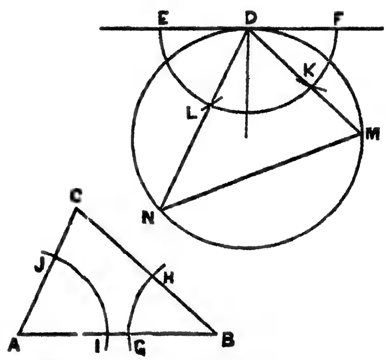
From B and D, with the same radius, describe arcs cutting each other in F.

From D and C, with the same radius, describe arcs cutting each other in G.

Join F G, F E, and G E, which will complete the triangle about the circle.

It will be seen that by this problem an Equilateral Triangle may be constructed about another, the whole consisting of four equilateral triangles.

Within a given Circle, to inscribe a Triangle similar to a given triangle, A B C (Fig. 155).



Draw a radius to any point, and a line at right angles to it—this will be a Tangent.

From the tangent point, D, with any radius, describe a semicircle cutting the tangent in E and F.

At A and B, with radius D E, describe arcs cutting the sides of the triangle in I J and G H.

From the point F, mark on the semicircle the length of the arc, G H, viz., F K.

From E, mark on the semicircle the length of the arc, I J, viz., E L.

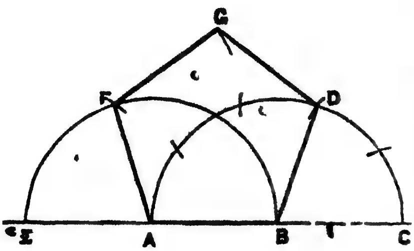
From D, draw a line through K, cutting the circle in M.

From D, draw a line through L, cutting the circle in N.

Draw M N, which will complete the Triangle in the Circle.

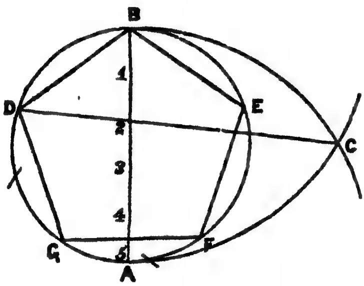
To construct a Regular Polygon—in this case a Pentagon—on the given line, A B (Fig. 156).

Polygons may be constructed by either *general* methods—that is, by rules, which by simple variation as to division of parts will apply equally to all polygons—or by *special* rules, which apply to particular figures only. The present mode of constructing a pentagon is a general one, and may be employed in the formation of any other polygon. Thus, to construct a heptagon by this method, divide the semicircle into seven equal parts; for an octagon into eight, and so on; but it must be remembered that, whatever may be the number of parts, the line A D must always be drawn to the *second* division.



Produce A B on each side.
From B, with radius A B, describe a semicircle cutting A B, produced in C.
Divide the semicircle into five equal parts.
From B, draw B D to the *second* division.
From A, with radius A B, describe a semicircle cutting A B, produced in E.
From B, mark on this semicircle the length of the arc A D, viz., to F.
From D and F, with radius A B, describe arcs cutting each other in G.
Draw D G and F G, which will complete the Pentagon on A B.

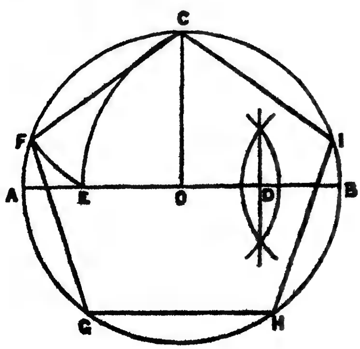
To Inscribe a Regular Polygon—in this case a Pentagon—in a given Circle (Fig. 157).



Draw the diameter A B, and divide it into as many equal parts as the polygon is to have sides. (In this case five.)
From A and B, with radius A B, describe arcs cutting each other in C.
From C, draw a line passing through the *second* division, and cutting the circle in D.
Draw D B, which will be one side of the polygon.
Set off the length, D B, around the circle; viz., E F G. Join these points, and thus complete the figure.

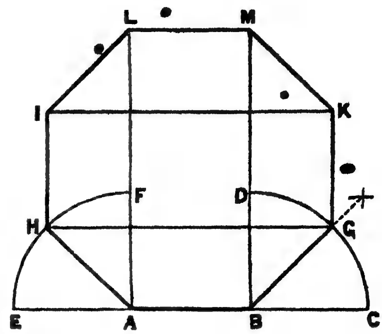
Any polygon may be thus formed,—by dividing the diameter into the number of parts corresponding with the sides of the required polygon; but the line, C D, must, in *every* case, be drawn through the *second* division.

To Inscribe a Regular Pentagon in a Circle, by a special method.



Draw the diameter A B.
At O, erect a perpendicular, O C.
Bisect the O A in point D.
From D, with radius D C, describe an arc cutting A B in E.
From C, with radius C E, describe an arc cutting the circle in F.
Draw C F, which will be one side of the Pentagon.
Set off the length, C F, around the circle, viz., G H I.
Draw lines, F G, G H, H I, and I C, which will complete the figure.

To Construct a Regular Octagon on the given line, A B.



Produce A B on each side.

Erect perpendiculars at A and B.

From A and B, with radius A B, describe the quadrants C D and E F.

Bisect these quadrants, then A H and B G will be two more sides of the Octagon.

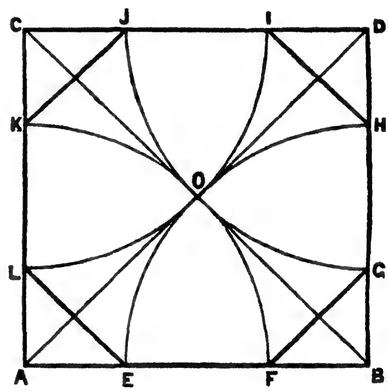
At H and G draw perpendiculars, G K and H I, equal to A B.

Draw G H and I K.

Make the perpendiculars A and B equal to G H or I K, viz., A L and B M.

Draw I L, L M, and M K, which will complete the Octagon.

To inscribe an Octagon in the Square A B C D.

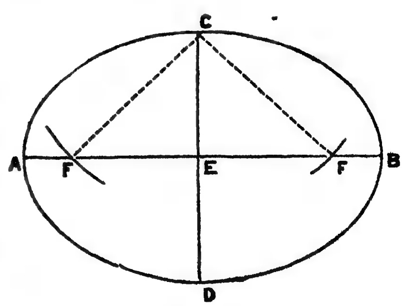


Draw diagonals, A D and C B, intersecting each other in O.

From A B C and D, with radius equal to A O, describe quadrants cutting the sides of the square in E F G H I J K L.

Join these points, and an Octagon will be inscribed in the Square.

To draw a perfect Ellipse by means of string and pins—a method of great service to masons, joiners, gardeners, &c. (Fig. 161).



Place the given diameters, A B and C D, at right angles to each other at their centres, E.

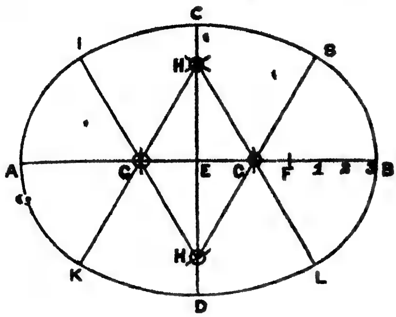
From C, with radius E A, cut the long diameter in F F.

These two points, F F, are the *foci* of the Ellipse.

Place a pin in each of these, and another in C. Pass a string round the three pins, and tie it securely, thus forming a triangle of string, F F C.

Take out the pin at C, and substitute a pencil, which may be drawn along, moving within the loop, and the point will thus trace a perfect Ellipse.

To construct an Elliptical figure by means of arcs of circles (Fig. 162).



Place the two given diameters, A B, C D, at right angles to each other, at their centres, E.

From A, set off A F, equal to C D.

Divide F B into three equal parts.

Set off two of these points on each side of E, viz., G G.

From G G, with radius G G, describe arcs cutting each other in H H.

From H H, draw lines through G G, and produce them.

From H H, with radius H C or H D, describe arcs cutting the lines H G produced, in the points I J K L.

From G G, with radius G A or G B, describe arcs meeting those drawn from H H, in I J K L, which will complete the figure.

TO PAINT, STAIN, AND VARNISH WOODWORK.

Although house-painting is not by any means an agreeable, or even a healthy occupation, a few hints in regard to it may be found useful by the amateur, who, having succeeded in erecting some of the structures described in the foregoing pages, wishes to complete his work by painting it, or who, even though he may not care to do this himself, desires to be in a position competently to direct the work of those he may employ. We shall, therefore, omit all the rougher portions of the work, such as grinding colours, &c.; since the colours ready prepared, and all other materials, may be purchased at the colour-shops; and it is by far the wiser plan for the amateur to buy them there, confining his efforts to diluting them, mixing tints, and the practical work of laying on the colours.

We will, therefore, suppose that a newly-erected wooden structure is to be painted. It will, of course, be evident that the surface when finished must present an even appearance, and that it must not be dull in one place and glossy in another; and as the fibres of wood run more closely together in some parts than at others, the equalization of the colour, so that this may not appear, is one of the greatest efforts of the painter.

The first process in painting new wood is that of filling in the knots, which generally present circular or elliptical spots—the cross ends of fibres to the surface; and it is necessary that the pores of these, which are, as it were, the open ends of a number of tubes and the spaces between them, should be stopped. The material used for this purpose is called "knotting;" a composition made principally of red lead and boiled oil, with other ingredients, according to various receipts. The amateur will best accomplish his purpose by purchasing the article sold as "patent knotting," which is to be applied

with a "tool." This leads us to explain that this technical term must be understood in quite a different sense to that given to it in the previous section, and must be taken in its widest signification of "any instrument used by hand." The fact is, that by "tools" or "sash-tools," house painters understand the smaller-sized hog-hair brushes, which are used for painting the sashes of windows, mouldings, &c., the larger implements being called "brushes." Thus it is common to speak of the "pound-brush" the "tools," and the "fitches," which are the smallest hog-hair tools used for work where the tool would be too large.

The pound-brush is often used as a duster for some time before putting it into colour, by which it is rendered more soft for use. This is not, however, a good plan, as dust gradually becomes embedded in the tied-up portion of the brush, from which it is liable to work out subsequently, thus making the work gritty. There is a proper brush, called the "duster;" it differs from the ordinary painting-brush, inasmuch as that the hair spreads out wider at the end than in the others. Whilst on the subject of brushes, it may, perhaps, be well to refer to the annoyance of loose hairs coming out during work, trailing along, dragging colour with them, or if not noticed at the time, drying hard upon the surface, and when the painter indignantly removes them, leaving an uncovered streak or scratch. The plan found best to remedy this defect, which in good and well-made brushes will not last long, and which results from a few hairs not having been quite caught by the pressure of the surrounding string or tin, is to place the brush to soak for a few days in water, which causes the hairs to swell. When taken out, the principal quantity of the water may be removed by striking the brush against a stick or wall, and then placing it to dry. The force with which it is struck will bring out the ends of most of the loose hairs, which may then be removed by the fingers; and the water having worked its way up between the

hairs confined by the string, does not dry out as easily as that in the free ends, and they become subsequently fixed by the paint which fills up the interstices. This, at least, would seem to be the theory: the practice is, however, certain, and has often proved of great service to the Author, not only in house painting as an amateur, but professionally in fine art.

The first coat of paint is called the "priming," and is generally done with a mixture of white lead and red lead. In this and in the second coat, it is advisable that the pigments should be diluted with three parts of oil to one of turpentine, but a greater proportion of turpentine is used in the finishing coats. The number of coats of paint necessary must of course depend on the absorbent nature of the materials to be painted, some requiring a greater number than others. New wood generally needs four, and in some cases five, coats. Boiled oil is better for out-of-door, and linseed for indoor, work.

When it is intended to finish with a dark colour, the whole of the early processes may be made to contribute to that end. Thus, let us suppose that a door of an outhouse is to be painted black, dark green, or brown. A good priming colour, which is both cheap and durable, composed of vegetable black and white lead, may then be used.

When the priming is thoroughly dry, the work is to be rubbed down with fine glass-paper,—by this we do not mean it is to be treated like old iron from which it is desired to remove the rust, but is to be equally and lightly passed over with the glass-paper. A good plan is to wrap a piece of the paper or cloth round a flat block of wood, thus making, as it were, a small scrubbing-brush; the advantage of which is that it is flat, and so does not rub more on one part than another, which the paper merely held by the fingers is likely to do. For mouldings and rounded surfaces the glass-paper should be rolled over a pad or ball made of a piece of rag.

After this, the holes caused by the heads of nails having been punched below the surface, all cracks and other superficial defects are to be made good: this process is called "stopping." It consists in pressing a composition called "hard stopping," made of putty and white lead, or either one of these separately, into the inequalities by means of a short broad and stiff knife, such as is used by glaziers in laying putty round the sash to be glazed. And here, perhaps, another practical hint may be of service. When the hole to be stopped is shallow, it should be deepened with a gimlet or brad-awl—a screwed gimlet is the best—or several smaller holes should be bored in opposite directions, or, if the surface be a thin one—as a panel in a door—the delve should be scored over with the point of a sharp tool, or otherwise roughened, so that the stopping may have a hold, otherwise it is likely to fall out under the action of the sun, leaving the original fault more visible than ever, from its appearing in the middle of a well painted surface.

We are, of course, aware that the amateur will now be very desirous to get his work, which has advanced thus far, finished as soon as possible; but even in view of this we must still strongly urge patience, that virtue which is so much lauded, but which is, unfortunately, possessed by so few. And we would urge the amateur not to touch his work now for at least a couple of days or more, until a good skin shall have formed over the stopping—in fact, the harder it has become the better.

All dust left by the glass-paper should now be carefully removed with the duster, and the second coat applied: this consists of the same colour used for the priming, and should be allowed to become quite hard, when the glass-paper and duster are again to be used, and the third coat is then to be proceeded with. This coat should be made to approximate, in some degree, to the final colour. Thus, if the work is to be finished in a light colour, the third coat should be made of

white lead slightly tinged with that colour, and increased attention should be given to the smoothness and uniformity of the surface: as already mentioned, the proportions of oil and turpentine should now be varied, and in the third coat may be about equal.

If, when the third coat is dry, there should still be places which are much more glossy than others, it will prove that the absorbent qualities of the wood have not been entirely overcome, and it will be better to apply an additional coat than to run the risk of spoiling the work.

The fourth, or finishing painting, affords an opportunity of giving a few hints as to manipulation.

In the first place, let it be assumed that you have had the colour sent you from the colourman's, ground in oil, and you wish to mix it—first, so that it may reach the desired shade; secondly, that it may be of the proper consistency for work. Of course, as already stated, you can in towns get this already done and sent to you; but, if your residence be in the country, it is more convenient to have the pigments sent ground up in oil, and mix them yourself; for, of course, the more solid the colour, the less space does it occupy, and the more convenient it is for transit. White lead, the basis of almost all colours, the necessary oils and turpentine, can be kept in store, and you will then be able to accomplish your purpose with the utmost ease.

Now, let us suppose that the cupboard, page 43, is to be painted, and that the colour chosen is to be French grey—which may be composed of White lead, Prussian blue, and Lake. The colours should be mixed on a slab, not in the paint-pot. The Lake with White first, then the Blue, should be sparingly added, for it is such an exceedingly powerful colour that a very little goes a long way, and if the tint becomes too dark, more and more Lake and White will be required to lighten it, and thus a greater quantity will possibly be mixed than may be required.

The colour on the slab, although the same in hue as that required, should be darker, so that when mixed with a greater quantity of white

it may reach precisely the right tint; more and more white should be added on the slab, the whole being mixed with the palette-knife until it becomes too thin to rest on a horizontal surface, when it is to be transferred to the paint-pot, to be further mixed with the white already there. The whole should then be well stirred, either with the palette-knife or a stick, so that the tint may be incorporated with the white.

If the shade should not be found dark enough, more colour should be mixed on the slab, and added; but the pure colours should never be put directly into the paint-pot, where a little lump may settle down, be taken up by the brush, and be deposited, perhaps, just as the last stroke is being given. It is further advisable to mix only a small quantity at first, so that the effect may be tried, as some colours look very different when spread over a surface than when in a mass.

At the close of each day's work, the brush should be scraped with the palette-knife, and as much paint taken out of it as possible; it should then be put in a pot with water. The paint in the paint-pot should also be covered with water, to be poured off when the paint is wanted again.

In painting, the great result—a perfectly flat surface—should be constantly kept before the mind's eye. The colour should be at first laid on in the general direction of the surface, and when some convenient quantity has been covered, the brush should be worked crosswise at right angles to the previous direction, thus breaking down all longitudinal streaks and ridges. The work is then to be "laid off," by working the brush in the original direction, agreeing with the fibres of the wood. The touch should be light and free, the points only of the hairs of the brush being called into action—the hair skimming as it were over the surface, so that no brush-marks of any kind may be left, and this should be carried quite up to the edges of the panels, so that the middle part, however smooth, may not be surrounded by rough bordering—a fault too often visible in second-class work.

The doors of the cupboard will look well if the framing is painted

rather darker than the panels (which should be of the palest tint, nearly white, in fact), and the mouldings just one degree darker.

"Flatting" is a method of painting in which the surface when dry is perfectly dull, without any of the gloss of oil-painting. This result arises from the fact that the finishing colour is diluted entirely with turpentine, instead of oil. It requires rapid working, as the turpentine dries very quickly, and therefore, if a large surface is to be covered, an assistant must be employed. It is not, however, supposed that the amateur carpenter will be likely to undertake such work on a very large scale, and further instructions on this head are, therefore, unnecessary.

If the wood employed has been painted before, the surface will require rubbing with pumicestone and water, and some parts may also need the application of turpentine. All bad places will require making good with stopping, and the number of coats will depend on circumstances.

Having thus given a general outline of the processes of painting as far as they are likely to be of service to the amateur carpenter, we now proceed to show how woods may be stained and varnished. For external work this is, of course, not as effectual as oil-painting, by which process wood is in a great degree protected against the effects of the weather; but for indoor work, as in the case of the book-shelves, the wardrobe, &c., staining and varnishing answer very well indeed. There are many ways of mixing up the stains to imitate the various woods; but it is scarcely worth the while of the amateur to attempt to make these, as excellent stains are sold at a very cheap rate. We need only, therefore, describe the mode of application.

In the first place, then, the whole surface of the wood must be rubbed with fine glass-paper—wrapped, as already described, round a flat piece of wood. In doing this, the motion of the hand should not

be merely in the way of the fibres of the wood, but also crosswise and in a circular direction, taking care to finish off in such a manner that no marks of the glass-paper are left, and certainly that there are no indentations or scratches. Glass-cloth may also be obtained, and will be found very useful, as it becomes soft and may thus be pressed into the mouldings and curved parts; a strip of it may also be wrapped round a pointed piece of wood, so that the angles and interior curves may be reached. We are thus particular because there is nothing that so spoils the effect of wood, whether painted or stained, as a gritty appearance: and this may be easily avoided by a little care in the operation described. The dust produced by the glass-paper must not only be brushed off with the dusting-brush, but the whole surface should be rubbed with a cloth—such as a piece of towelling—the surface being thus rendered perfectly clean and smooth.

Some of the staining is then to be poured into a basin; but it will be found to be much too strong for use unless the darkest woods are required; it will, therefore, be necessary to dilute it, which is very easily done by mixing some hot water with it. Only a very little water should be poured into the colour at first, and this should be well stirred with a spoon or stick so that the whole may be of equal consistence; more water may then be added as required. It must be borne in mind, that if the wood has been stained too dark it cannot be lightened, whereas if it should be found to be too light it can easily be darkened by another wash of the staining: this hint will, perhaps, prevent the amateur spoiling the appearance of his work.

The wood to be stained should, whenever it is possible, be placed in a horizontal position, so that a good and full wash may be given without the liquid running down; the staining may be applied with a brush or sponge. It should be laid on evenly; pools of it should not be allowed to remain, but should be carried along or dipped up. When the structure has been fixed in its place, the stain must be ap-

plied very sparingly, even though another wash may thus be rendered necessary. Whilst the sponge or brush is applied by the right hand, a cloth or another sponge should be held in the left with which any colour about to run down should be arrested, as each separate stream as it trickles down will be likely to make a streak which will be darker than the other part.

Although the staining is supposed to be done in flat washes, the taste of the amateur can still find means of improving the form of the grain: thus, although a piece of pine may be stained to the colour of walnut, the grain will still be very different; and the work in this respect may be improved by darker veining, done in an off-hand sort of way, not by any means attempting to emulate the work of the grainer. These touches, knots, &c., may be put in with a tool or a piece of rag; and by dipping a piece of rag into hot water, and wrapping it round the thumb, some parts may be lightened, by which the effect is very much improved.

When the staining has become perfectly dry, the work must be sized. The size may be purchased together with the staining: it is sold in cakes of about the thickness of $\frac{1}{16}''$. These cakes are to be broken up, and put in a jar or basin, with plenty of hot water, to melt. Again we must warn the amateur as to the thickness and quantity of the size he uses: if it is too thick, or if it be laid on in too heavy washes, it dries on the surface instead of being absorbed, and assumes the shape of drops, or "tears," or other irregularities, and afterwards peals off with the varnish which has been applied over it, leaving the unvarnished surface exposed to view.

It is, therefore, by far better to apply the size in two thin coats, care being taken that the one is perfectly hard before the other is applied.

When this has been successfully accomplished, the varnish is to be applied. The varnish and varnishing-brushes, like the size, may be

purchased together with the staining. Great care must be taken of the brush, as much of the beauty of the varnishing will depend on the fineness of the brush: when done with, it must be very well washed out in turpentine, and when all the varnish has been squeezed and wiped out of it, it should be washed in warm soap and water, after which it should be rinsed in clean warm water and made perfectly dry. The varnish must be applied rapidly; the surface being well covered, but no superfluous quantity being left. If possible, a dry day should be chosen for the operation of varnishing, or, at all events, the room should be warm, though not too hot.

As the child's crib, desk, and other articles described will require French polishing, and as this art is easily acquired by a little practice, the following few hints on the subject are given.

The surface to be polished must be well rubbed with glass-paper, so that all scratches, however small, may be removed, for every defect and every roughness will appear even worse than before when covered with the polish. Great care must also be taken to rub off all dust immediately before the process is to be commenced.

In the first place, as to the polish itself, it may be purchased ready for use; but in case it cannot be obtained, the following receipts are given:

1. To one pint of spirits of wine add ½ oz. of gum shellac, and a ¼ oz. of gum sandarach; submit the whole to a gentle heat, frequently shaking it, till the various gums are dissolved, when it is ready for use.

2. One pint of spirits of wine, ¼ oz. of gum copal, ¼ oz. of gum arabic, 1 oz. of shellac. The gums must be powdered in a mortar until they are quite fine: they should then be sifted through a piece of muslin. The powder should then be mixed with the spirit in a jar or bottle closely corked, which should be placed near a fire or oven, and frequently shaken and stirred. When the gums are

entirely dissolved, the mixture should be strained through a piece of muslin, and the containing vessel must be kept closely corked.

The next requisite is the rubber or pad: this is made by rolling up a piece of woollen rag or flannel into a ball; this, after being saturated with polish, is to be covered with a piece of linen or muslin drawn tightly over it. The rubber should be held between the fingers and thumb in such a manner that the covering may be drawn tightly over the woollen ball; the surface, however, should not be spherical but still convex, however slightly.

In commencing to work, pour one drop of linseed oil and one drop of polish on the pad, and apply it to the surface of the wood, working in a circular direction, using very little force, and extending the operation over about a square foot at a time, until the whole surface is covered. Equality in quantity of polish and in force is the great desideratum, and this is attained, first, by squeezing the pad so that more polish may exude when required, and secondly, by carefully regulating the pressure applied.

When the surface has been thus covered, the process is to be stopped for a couple of hours or so until the polish has become thoroughly hardened. It is then to be lightly passed over with the finest glass-paper, so that any little roughness which may remain from the surface of the wood or the polish may be removed. The polish is then again to be applied; and it is possible, that when this is hard, it may be found desirable to rub it down again and repeat the process.

When this has been completed it will be necessary to remove the oil with which the polish will in some degree have become impregnated, and which will be found to give it a cloudy appearance. This is done by the application of a few drops of spirits of wine on a clean pad, first working in a circular direction, and then in the way of the grain, until the surface becomes dry. Methylated spirit is used for this purpose, and is sold under the name of "Finish." In this form the spirit is

much cheaper than if purchased in its pure condition, and it is equally useful.

In very porous wood the polish will, after the lapse of a few days, be found to sink, and in such cases a repetition becomes necessary.

Absolute success is generally, as far as manipulative processes are concerned, the result of care and practice. Repeated failures must not daunt those who wish to accomplish a certain end; and when it is understood that there is no mystery in the matter—that there are no complex conditions to be fulfilled—but that if the polish has been properly made, and if it shall have been properly applied, the surface *must* become properly polished—the amateur will, we have no doubt, attain by practice the necessary amount of manual skill by which he will be able to add so much beauty to his work.

THE END.